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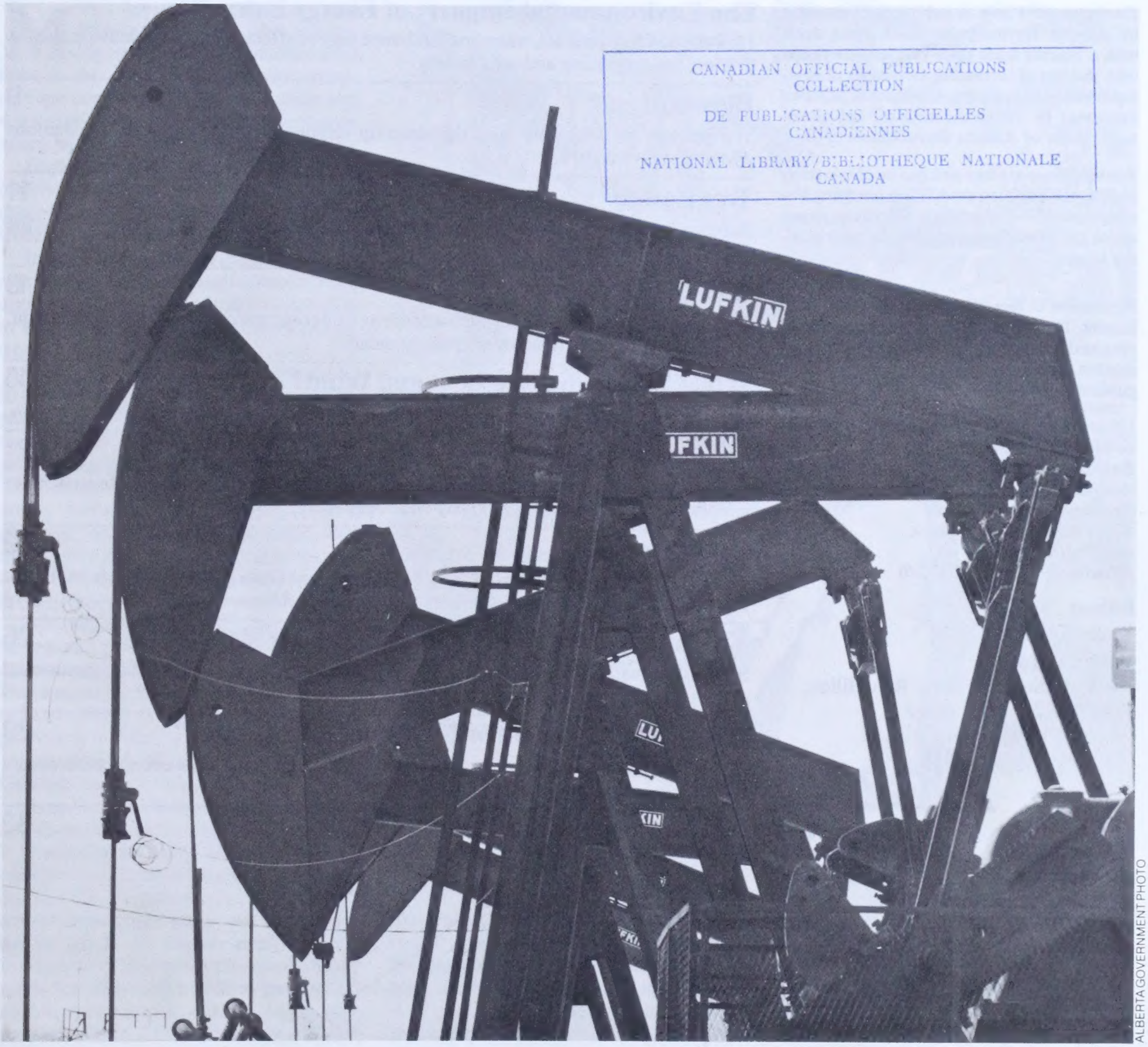

ALBERTA GOVERNMENT PHOTO

Energy and the Environment: I

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ENVIRONMENT VIEWS

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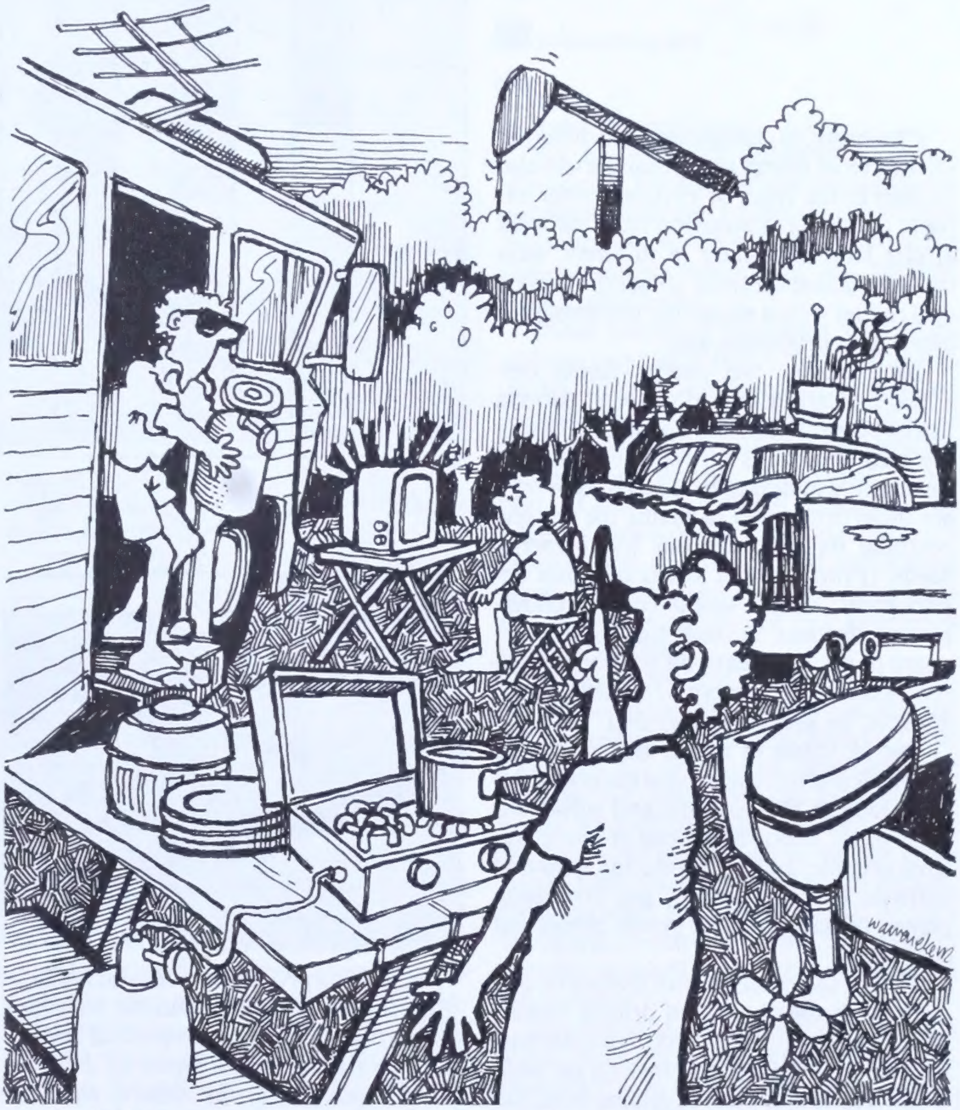


Look at that! Oil pumps bumping and grinding everywhere disturbing our peace and quiet!

Man's heavy reliance upon fossil fuels presents him with a perplexing paradox: how to maintain the lifestyle he desires without destroying, through energy extraction, production and consumption, the natural environment upon which all life ultimately depends.

Forecasts range from predictions of an impending environmental catastrophe to cheerful reassurances about the omnipotence of technology to solve our problems.

In any case, resolution of energy's environmental challenge depends upon a realistic appraisal of the existing situation, surveyed in a historic context and against evolving trends.

This issue of *Environment Views* seeks to review the environmental impacts of exploration, extraction and production (the next issue will deal with energy transmission and consumption). While acknowledging the enormous economic implications involved--including our dependency, as a province, on resource development, and the often-high cost of environmental protection--it is beyond our scope here to tackle these questions.

And while environmental impacts may be regional or even global in nature, the complex and weighty nature of the subject forces us to restrict our view to the relatively-local effects of energy extraction and processing in Alberta.

But Alberta, 'the energy province of Canada,' is a good place to begin.

According to figures from the energy and natural resources department, Alberta is responsible for about 85 per cent of the conventional crude oil produced in Canada. In 1978, the province's production of conventional crude was about 378 million barrels (about 60 million cubic metres). Production of synthetic crude from the oil sands was about 20.1 million barrels (3.2 million cubic metres), and natural gas production totalled 2.135 trillion cubic feet (64 billion cubic metres).

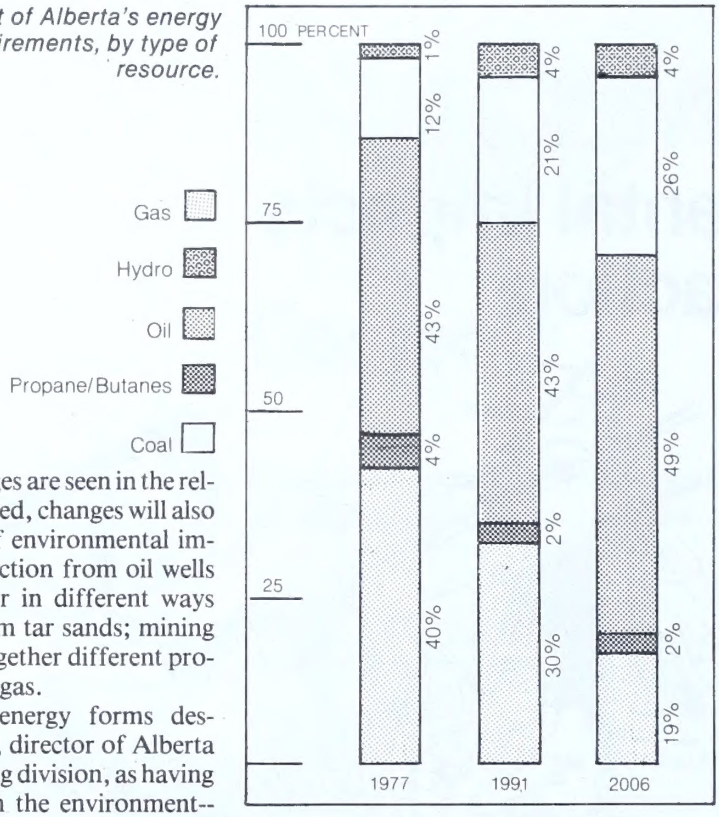
About 13 million tonnes of coal are produced annually in Alberta's coal mines. The province is the fourth largest producer of electrical energy in Canada, having generated about 18 million megawatt hours last year.

The Energy Resources Conservation Board (ERCB), a provincial body with resource and environmental management functions regarding oil, gas, oil sands, pipelines, electric energy and coal mining, says in a report on future energy requirements in the province that Albertans themselves will use four times the energy in 2006 that they did in 1977. Consumption will be up from some 680 trillion BTU (British thermal units) to about 2,300 trillion BTU.

To meet these requirements, there will be changes in the relative amounts of the different energy forms used. Oil, says the ERCB report, will still be the primary energy resource--its use is projected to increase from 43 to 49 per cent of the energy consumed--although depleting supplies of conventional light and medium-weight oil will be supplemented by production from the oil sands and heavy oil reserves.

Gas is projected to decline in relative importance from 40 to 19 per cent of the total, with coal increasing from 12 to 26 per cent by the end of the century.

ERCB forecast of Alberta's energy resource requirements, by type of resource.



1 LAUREN DALE

Obviously, as changes are seen in the relative types of energy used, changes will also be seen in the types of environmental impacts occurring. Extraction from oil wells affects land and water in different ways than extracting oil from tar sands; mining coal carries with it altogether different problems than processing gas.

Significantly, the energy forms described by Carl Primus, director of Alberta Environment's planning division, as having the greatest impact on the environment--surface coal mining and oil sands recovery--are those often cited as having the greatest potential for supplying our future energy needs. (Primus places in-situ oil sands development, which would recover underground deposits through the injection of steam or air, and heavy oil development in the 'mid-range' category of environmental impacts; see article on page 29.)

But all forms of energy extraction and production affect the natural environment. Let's look at the potential and actual impacts of six major categories of energy-related activity: drilling, producing wells and batteries (defined below), gas processing plants, oil sands plants, power plants and coal mines.

One of the concerns with *drilling oil and gas wells* is the disposal of drilling wastes, which can amount to 50,000 to 60,000 barrels (8,000 to 9,500 cubic metres) per well. These wastes may include drilling mud, oil, chemicals to lubricate equipment, biocides and salt water, some of which, if leaked in high enough concentrations onto land or into fresh water bodies, can be toxic to fish and vegetation. In 1975 the ERCB and Alberta Environment issued a directive requiring the treatment of large volumes (greater than 6,000 barrels or 950 cubic metres) of wastes to reduce toxicity when they are to be disposed of on land and off the lease.

Other impacts of exploration and drilling are the cutting of seismic lines and other surface disturbances such as road building, plus wells flowing out of control and noise from drilling rigs.

2 ALBERTA GOVERNMENT PHOTO

Regarding *producing wells and batteries* --the latter being installations including tanks to separate oil from gas and impurities--the ERCB's 1972 *Status of Environment Protection in the Alberta Resource Industries* says "a major source of pollution is the hydrogen sulphide (H_2S) contained in sour oil and gas."

Hydrogen sulphide, detectable by its 'rotten egg odor' at a concentration of about 0.01 parts per million (ppm), is an irritant in higher concentrations to the respiratory system, and poses a health hazard over prolonged exposure when concentrated in the range of 10 to 50 ppm. Sources may be storage tank vapors, pressure vessel leaks and leaks at the pump and wellhead.

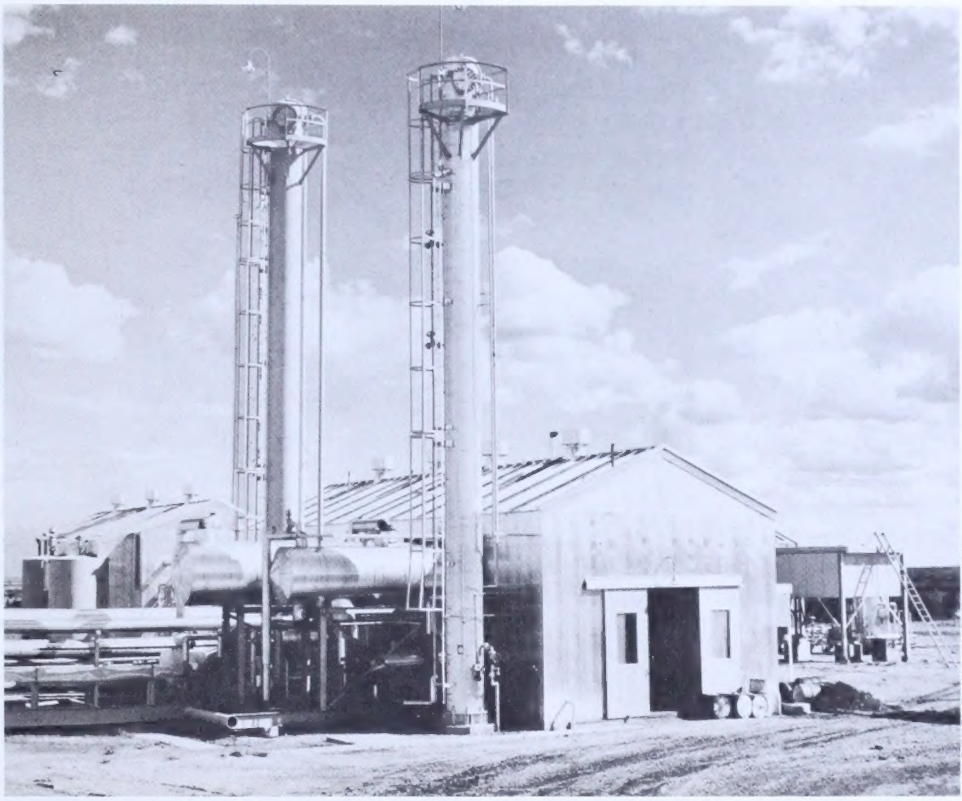
An air quality study by Alberta Environment from late August to November 1, 1978, in the Redwater oil field about 60 kilometres northeast of Edmonton, noted 1,174 hydrogen sulphide readings in excess of ambient (ground level) standards set by the Alberta Clean Air Act's regulations.

Averaged on a 24-hour basis, Alberta Environment's most accurate monitor showed that, at the four monitoring sites on the oil field, the percentages of readings in excess of the standards were 53.2 per cent, 53.7 per cent, 50 per cent and 11.1 per cent.

Actual readings peaked as high as .978 ppm at one site, beyond which the monitor could not go, although the highest 24-hour running average was .12. "While a direct health hazard from hydrogen sulphide concentrations in the order of 0.01 to 0.1 ppm is difficult to establish from available literature," said the report by Alberta Environment's air quality branch, "prolonged exposure to the characteristic hydrogen sulphide odor poses a definite nuisance and with some individuals will bring about personal discomfort."

The ERCB's report on environment protection cited "leaks or spills of oil and salt water, smoke, pit storage of salt water, noise, surface excavations and weed growth" as other potential problems relating to producing wells and batteries.

Salt water spills--usually from the short pipelines that move the water to disposal wells where it is sent back into the formation from which it came--are a relatively unpublicized phenomena. But they are definitely on the rise, in contrast to the declining volume of oil spilled. In 1978, about 37,000 barrels of oil (5,900 cubic metres) were spilled, compared to just over 107,000 barrels (about 17,000 cubic metres) of salt



3 ALBERTA GOVERNMENT PHOTO

*Starting up the familiar oil well 'donkey' or pumpjack.*1

*Oil spill containment test near Drayton Valley.*2

*Paddle River gas plant.*3

water. (Of the latter, 67,000 barrels were from a major spill in the Redwater field.)

Half as much salt water as oil is produced by the province's wells, says Ed Brushett, head of the ERCB's Environment Protection Division, and the approximate 500,000 ppm total dissolved solids in some of the salt water "would put the dead sea to shame."

The ERCB's report on environmental protection says salt water mixed with surface or underground fresh water could make the water undrinkable; on land, the sodium, calcium and magnesium chlorides, plus the sulphate salts in the water could kill plants and leave the soil susceptible to erosion.

Oil spills, of course, coming from sources such as pipeline breaks and leaks in storage tanks, pressure vessels and wellheads, are still a serious pollution concern; there were 378 oil spills of various sizes in 1978.

Depending on the concentration, oil can be toxic to aquatic plants and animals; a study by Alberta Environment's water quality control branch documented changes in the invertebrate population downstream of a December, 1974, pipeline break into the House River in northern Alberta. Oil can also be toxic to vegetation on land, and can change the soil's character. (Further attention to these subjects will be given in the next issue of this magazine.)

The most serious air pollution problem associated with *gas processing plants* is the emission of sulphur dioxide; this industry was responsible for about 884 tonnes per day, or about 68 per cent, of the sulphur dioxide emissions from all of Alberta's industrial sources in 1977.

The gas plants must remove hydrogen sulphide from the gas before it goes to market. It can either be converted to elemental sulphur, or, if the plant is small, flared into the atmosphere, becoming sulphur dioxide (SO_2). As of January 1, 1979, according to ERCB figures, there were 103 sour gas plants in the province, of which 46 recovered sulphur.

However, because the plants recovering sulphur are the largest ones, the total percentage of sulphur recovered from the gas was just under 97 per cent in 1978, up from 94.5 per cent in 1971.

Sulphur dioxide emissions from sources including sour gas flares and gas plant incinerator stacks can, at increasing concentrations, cause an unpleasant odor, plant damage, corrosion of metals, building materials and fabrics, and aggravate respiratory illness.

Some gas plants still exceed provincial SO_2 limits under certain conditions, said Brushett. "It doesn't matter how high a stack you put up, it's statistically probable that atmospheric conditions will occur such that SO_2 will hit ground levels at concentrations greater than those permitted by the standards. The stacks are designed so that most of the time, limits won't be exceeded at ground level. There's no way to keep them from exceeding, all of the time." An environment department spokesman added that technical problems and emergency upsets were most often the cause of excessive SO_2 emissions.

But the situation seems to have improved over the last ten years as legislative standards have been tightened, monitoring procedures have become more universal and measuring equipment has become more sophisticated.

Other potential problems associated with gas processing plants are created, said the ERCB environment protection report, by emissions of sulphur dust, smoke, and the disposal of waste process water. Brushett said the ERCB recorded 76 reports of smoke in 1978. A spokesman for Alberta Environment's water quality branch said only seven gas processing plants have a regular discharge to streams or other water bodies and "we have good control" on them.

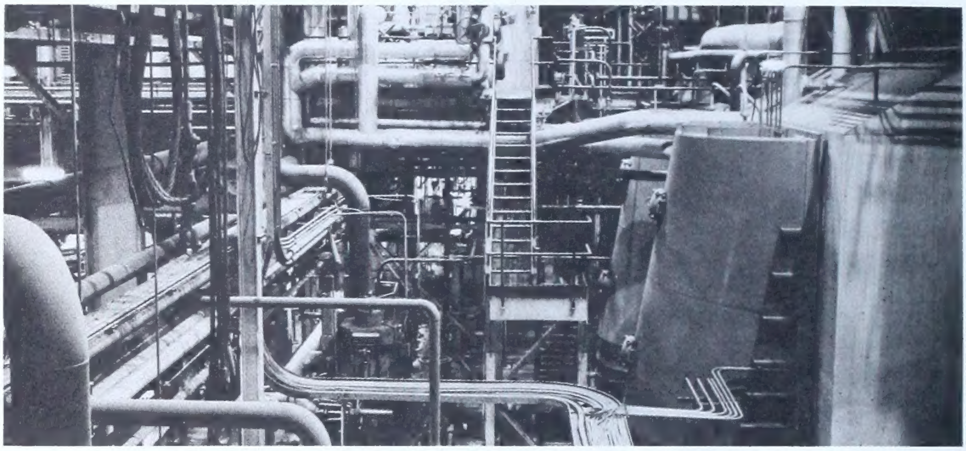
Sulphur dioxide is also the most abundant gaseous pollutant from the two *oil sands plants* in northeastern Alberta, Great Canadian Oil Sands Ltd. and Syncrude Canada Ltd. (the latter has only recently begun production). Last year GCOS emitted about 285 tonnes of SO_2 per day from its two main stacks, a figure which appears fairly constant from year to year; in 1977 the operation was responsible for about 17 per cent of the SO_2 industrial emissions in the province.

According to a report by the Alberta Oil Sands Environmental Research Program (AOSERP), at GCOS there were 64 SO_2 half-hour readings in excess of provincial standards in 1976, down from 154 in 1975 and 85 in 1974.

GCOS also has had a particulate problem from the burning of coke in its powerhouse, said Mark Strosher of Alberta Environment's air quality branch, but the company is installing electrostatic precipitators to control the problem of flyash emissions.

There are also nitrogen oxide emissions --the product of any combustion process-- as well as hydrogen sulphide and hydrocarbon emissions. The emission levels of these pollutants are potential concerns but do not now constitute a health hazard, said Strosher.

Inside a thermal power plant. 4
Land surface-mined for coal near Wabamun. 5



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Primus cited storage of tailings, or wastes from the oil sands refining process, as "the greatest environmental challenge" (for more detail, see articles on pages 26 and 29). The ERCB environment protection report noted that the constituents of utility water released to the Athabasca River from GCOS were kept within environment department guidelines.

Regarding Alberta's 21 *power plants*, most of the air pollution appears to come from the four which burn coal rather than natural gas or oil: Calgary Power's two plants near Lake Wabamun west of Edmonton, Alberta Power's Battle River plant and--especially--Alberta Power's H.R. Milner plant just north of Grande Cache.

The problem, generally, is the flyash produced by burning coal, says Bill McDonald of Alberta Environment's air quality branch. "They have to meet a limit of .2 pounds (.09 kilograms) particulate matter per 1000 pounds (450 kilograms) of flue gas (all have electrostatic precipitators to capture most of the ash) but there is still some flyash emitted."

Coal-burning plants also produce sulphur dioxide, although McDonald said there had only been one reading between 1975 and 1977 in excess of ambient limits set by the Clean Air Act's regulations (the plants emitted 31,000 tonnes of SO_2 in 1977, or about 85 tonnes a day).

Both coal-burning and gas-fueled plants emit oxides of nitrogen, which have been correlated in relatively high concentrations with plant damage and respiratory disease. One of ambient monitoring stations for the two Edmonton power plants--Rossdale and Clover Bar--has detected some readings in excess of provincial ambient air regulations, said McDonald, but they may have been largely caused by automobile emissions in the vicinity of the stations.

So the biggest problem is with the coal-fired plants, and their biggest problem is with particulates. The particulates problem can be categorized, according to McDonald, as high stack emissions and ambient level concentrations.

Regarding stack emissions, all plants basically meet the provincial limits except the Milner plant, which burns coal with a particularly high ash content and has an undersized precipitator to remove the ash, said McDonald. However the plant is building a huge 'bag house' which should solve the problem.

On the ambient (ground level) side, the plants are monitored both for total dustfall --including flyash, coal dust, road dust-- which is "more a nuisance than a health hazard," and suspended dust, which can be more of a problem because it is breathed into the lungs.

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Again, said McDonald, the Milner plant has had the most serious problem with dustfall, with monitoring devices showing 30 of 48 readings in 1977 in excess of provincial limits (one explanation for this may be that it is just downwind of the McIntyre Mines operation).

The Grande Cache plant just began its monitoring for suspended dust, but of the other three coal-fired plants in Alberta, readings in excess of standards for 1977 ranged from zero per cent at the Wabamun plant, to 33 per cent at Battle River.

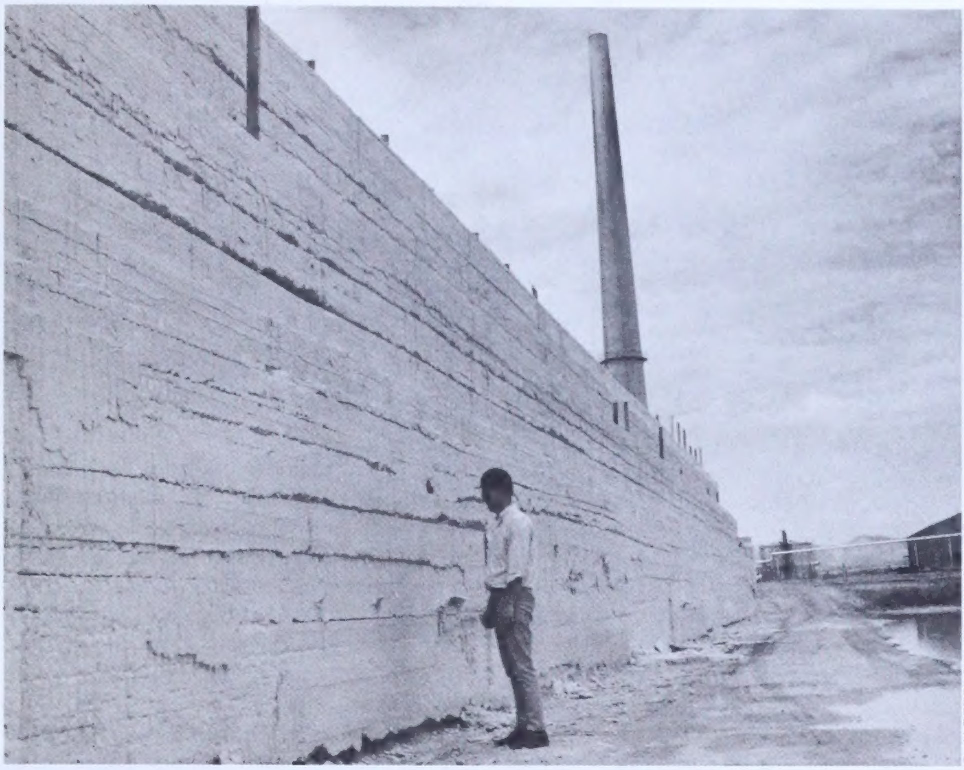
The ERCB's environment protection report cited another problem in thermal power plants: "Increases in ambient water temperatures caused by the discharge of large volumes of cooling water can have a serious effect on the ecological balance of a lake or stream. Increased water temperatures promote growth of aquatic plants which results in still more widespread changes in the habitat of fish and other aquatic animal life."

Hydroelectric plants, it added, "are pollution free in the ordinary sense, but affect the river valley in which they are located by changing the ice cover on the river, causing bank erosion, and by flooding the area of the reservoir."

Finally, the major pollutant resulting from *coal mining* is dust which, according to the ERCB report, arises "mainly from the large areas disturbed by surface mining, and from the handling and storage of coal." (In 1977 there were 34 coal mines in Alberta, with most production coming from surface mines.)

Water pollution can result "from water pumped from the mine or from deposition in lakes or streams of coal dust, rock dust or silt from eroded areas," as well as from chemicals used in coal preparation plants.

The most obvious impact created by surface mining is, of course, the removal of vegetation and disturbance of land. Clearing, road building and excavation can result in soil erosion; heavy rains or spring runoff may cause siltation of streams and lakes with its attendant problems, including de-



6 ALBERTA GOVERNMENT PHOTO

Sulphur stockpile at a gas processing plant in the Pincher Creek area.6

Land awaiting reclamation after surface mining.7

creased food supply for fish populations. Erosion, of course, can also be caused by clearing land for seismic lines, access roads, well sites and so on.

However, new reclamation requirements set by the provincial government should minimize long-term impacts. In fact, says Mike Day, assistant deputy minister for minerals disposition in the energy and natural resources department, "the area of active coal-mining is infinitely less than the clover-leaf developments" on highways throughout the province.

"You can do a far more sterilizing thing by putting a housing development on top of prime agricultural land," said Day in an interview, and many fewer people would complain of a housing development than of a coal mine.

The provincial legislation governing environmental protection is "broad and overlapping," says the ERCB's Brushett.

"Alberta Environment, under the Clean Air Act and the Clean Water Act, is ultimately responsible for environmental quality, but it doesn't set all the environmental standards nor do all the surveillance."

For example, the energy and natural resources department, under legislation such as the Land Surface Conservation and Reclamation Act and the Forest and Prairie Protection Act, as well as the department of recreation, parks and wildlife, under the Fisheries and Migratory Birds Act, all have environmentally-related responsibilities.

The ERCB "does the bulk of the surveillance" to detect and prevent pollution in the oil and gas industries, said Brushett. In this regard it has extensive preventative requirements and monitoring procedures for each phase of energy activity, although the ERCB depends "in large part"--as do the government departments--on data reporting by the industry itself.

7 LAUREN DALE

The board's requirements are particularly stringent where sour gas--that containing hydrogen sulphide--may be involved. For example, it requires that potential sour gas wells be drilled a certain distance from residential development; producing sour gas wells must bring the gas to the surface through tubing surrounded by inhibitor fluid (which quickly detects corrosion of the tubing) inside the well's casing, or lining. Valves must be capable of withstanding high pressures and a master valve must be installed at the top of the hole. In very sour gas wells located close to urban centres, fail-safe devices may be required to close off a well about 30 metres below the surface.

The ERCB's "biggest weapon" against problems at gas processing plants is its own staff, driving through the field, who can often tell by observation or smell whether emissions are dispersing, gas flares are unlit and so on, said Brushett. "We also depend a fair bit on the public to inform us about odors, etc."

But the ERCB also receives and checks regular emission reports from the plants, witnesses stack emission surveys conducted at the big plants several times a year, and conducts full-scale inspections at each major plant every three to five years.

Although prosecution of companies is "rather difficult" under the board's regulations, which Brushett described as having been written "administratively rather than punitively," the ERCB has "routinely shut in drilling rigs, production facilities--and come close to shutting gas plants--if they weren't in compliance with regulations. We do wield a club."

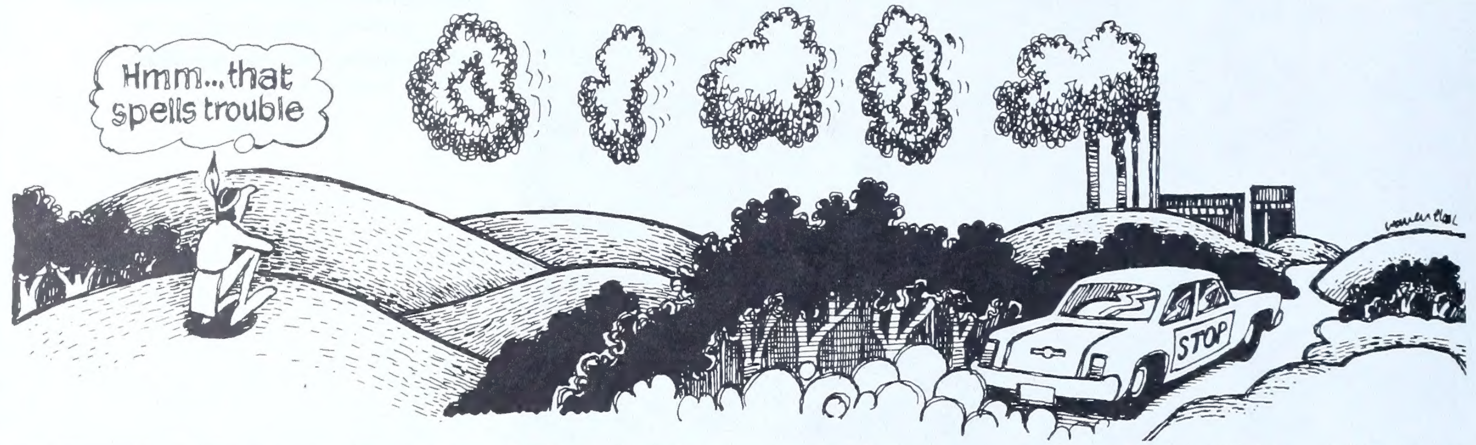
Alberta Environment has extensive requirements and monitoring procedures for the energy industry, and conducts, for example, continuous monitoring surveys for sulphur dioxide and hydrogen sulphide near sour gas plants. As well, it has established a network of 180 exposure cylinders to measure total sulphation and hydrogen sulphide near most of Alberta's sour gas plants, and requires that industry, too, conduct regular tests for different pollutants and submit the data to the department.

These types of requirements and procedures are applied by various government branches to all forms of energy-related activity to see that Alberta's environmental standards are met.

But what about the standards? How well are they protecting our natural land and water systems?

"The oil and gas industry has kind of a black name with people, but actually it's a good industry, certainly a very heavily-regulated industry," said Brushett. "We don't have a whole lot of problems."

Day added: You have to look fairly hard to find evidence of environmental degradation in the province. We can point to a few



bad examples in any country, but I think we've done relatively well in this province."

Day stressed that the province's economic well-being comes largely from resource wealth and that if Canada is to be competitive, it has to develop its natural resources. "I argue . . . put a gas well in. Don't let it smell or pollute our water, but, by jingo, that's where our money bags are."

Dixon Thompson, associate professor of environmental science at the University of Calgary's School of Environmental Design, believes Alberta should be assessing and further strengthening its environmental protection standards under the various provincial regulations.

"You have to make a distinction between adequate long-term protection and meeting existing government guidelines and regulations," he said in an interview. "For example, Calgary's sewage effluent flowing into the Bow River meets government standards, but is causing clearly identifiable problems as far as Medicine Hat . . . the algae growth is going bananas and plugging water intakes (for irrigation and municipal use).

"Alberta is in a very fortunate position with a high environmental quality compared to almost anywhere else in the world," said Thompson, "but we have an air pollution problem in Calgary and water problems in the province and we shouldn't let these things slip."

He acknowledged that it would be difficult to determine what constitutes adequate standards, since it's hard to know how much the environment can assimilate and also hard to 'assign' pollutants to their correct sources in relative amounts. But Alberta should begin the reassessment task as part of a preventative approach, he said.

Jean Poulin, research director for STOP (Save Tomorrow Oppose Pollution) adds that any process reviewing existing standards should include a mechanism for public input.

STOP, in its various campaigns to clean up industrial emissions, has learned that a significant 'loophole' exists regarding prosecution of companies under the Clean Air and Clean Water Acts, said Poulin in an interview: the legislation stipulates maximum permissible standards for various pollutants but does *not* say that to exceed them is an offense, legally.

Rather than prosecuting companies in violation of the standards, the director of pollution control or the minister can issue emission control orders or 'stop orders,' respectively. Poulin sees this approach as "discretionary, without the force of law."

Companies can only be prosecuted for violations of the operating conditions set down in their licenses under the Clean Air and Clean Water Acts, said Poulin, and firms in existence before this legislation came into being are given a period of time to apply for their licenses under the acts. The environment department generally won't issue a license until a company can meet the emission standards, and thus some companies may continue to operate while negotiating emission controls with the government.

In addition, under the legislation the environment minister may issue a 'certificate of variance' to a company if, among other things, the plant is likely to contravene a condition of its license "as a result of factors beyond the control of the applicant" or if "the variation is not likely to result in air pollution of a degree that could be detrimental to life or health or adversely affect property. . . ."

Serge Dobko of Alberta Environment's standards and approvals branch says that in the 2 1/2 years since provision for the certificate was first made, "10 to 14" had been issued, usually in regard to particulate or "dust" emissions.

"These are operations not yet meeting the requirements," he said, but the certificates are issued "on the basis that there is progress, that equipment is being installed so emission requirements will be met at some future date."

But provision for the certificates "is the straw that breaks the camel's back," according to Dennis Wighton of the University of Alberta's interdisciplinary committee on environmental quality.

"It is issued to industry so industry can operate without legal responsibility to the Alberta (Clean Air and Water) legislation," he said in an interview. "When (it) was developed we went back 30 years in time, in my opinion."

The Alberta government's unsuccessful attempt to prosecute Great Canadian Oil Sands Ltd. in 1977 on seven charges relating to particulate matter, visible emissions (smoke), effluent allegedly flowing into the Athabasca River and sulphur dioxide into the air, further demonstrated weaknesses in provincial requirements and a problem of inexperience in the environmental lobby, said Poulin.

This was particularly true of the SO_2 charge (laid under the company's license to operate), he said. In provincial court, the judge dropped it because, he said, the government had used, in its prosecution, data submitted to it under law by GCOS and the company was, in effect, incriminating itself. When appealed in district court, the judge dismissed the charge because, whereby the government's air quality standard was a half-hour average, the company's monitor took readings for a second or two every 12 minutes and these isolated readings, the judge said, might have been higher than the half-hour average from continuous monitoring would have been.

"The implication is that if a company doesn't have continuous monitoring equipment, it can't be prosecuted," said Poulin.

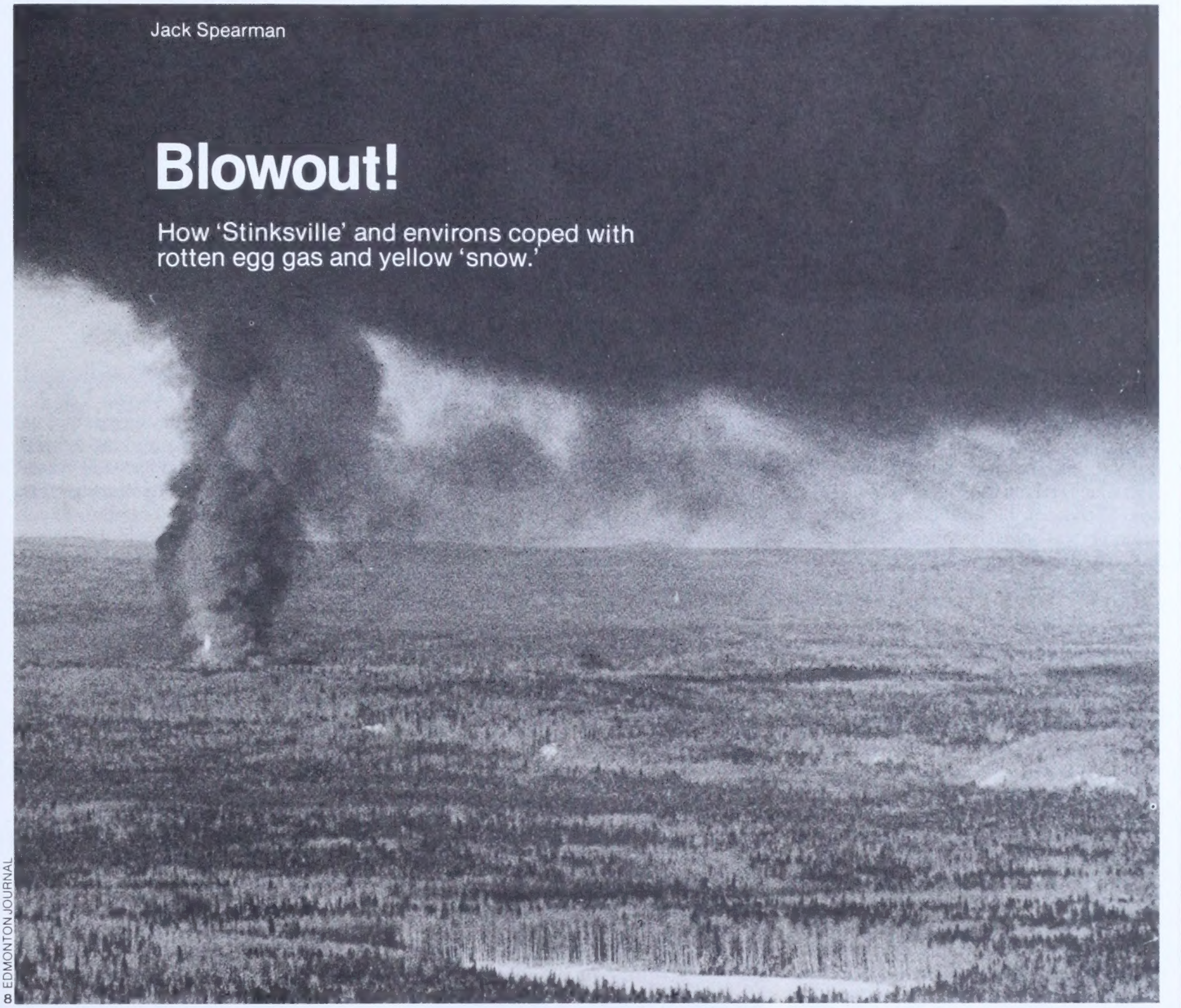
However, Mark Strosher of environment department's air quality branch said he believed the government could get farther ahead working with companies to reduce emission levels than prosecuting them. Al Schultz of the department's air quality branch said licensing requirements were being tightened to compel companies to perform more frequent, if not continuous, monitoring.

Kathy Kennedy is the freelance editor of this magazine.

Jack Spearman

Blowout!

How 'Stinksville' and environs coped with rotten egg gas and yellow 'snow.'



EDMONTON JOURNAL

Wild well.

Perhaps no other phrase in this petroleum-powered province conjures up so many vivid pictures in the imagination as the thought of massive subterranean forces casting aside the man-made contraptions intended to harness them.

There's the image of roaring flames, ten storeys high with the roaring racket of a jet engine at full throttle. Then there's the world-famous well capper, Paul 'Red' Adair, carefully planning each detail of the dangerous capping effort and slowly pacing around the wild well time and again, sizing up his opposition like a lion tamer circling the circus cage before going inside.

A wild well is one that allows an uncontrolled flow of oil or gas, or both. In a producing well, it might be caused by failure of special valves at the wellhead, or of tubing in the well hole.

But wells can also 'blow' when they are still being drilled. That's what happened in the case of the most famous blowout of recent Alberta history, when an Amoco well in the Lodgepole-Drayton Valley area went out of control December 6, 1977.

During the drilling, pressure of the gas in the bottom of the hole became greater than the pressure of the drilling mud being pumped in to keep the hole lubricated and the pressure balanced. So the gas forced the mud up to the surface, and kept right on blowing.

The Amoco well wasn't brought under control for almost a month, until January 2, 1978. By then, it had spewed potentially lethal hydrogen sulphide gas into the air, while hydrocarbons that escaped from the bottom of the 2,970-metre well combined with the atmosphere to produce a foul-smelling condensate that fell like a yellow snow over 1,100 acres around the well site.

The highly flammable condensate contaminated the Pembina River which flowed about 200 metres from the well and residents downstream had to truck water in at the height of the blowout. Trees that were coated with five centimetres of the condensate were lost and the sickening odor of hydrogen sulphide--so-called 'rotten egg gas' --drifted 220 kilometres northeast into Edmonton.

For almost a month, 20 million cubic feet (560,000 cubic metres) of gas a day simply disappeared. If the blowout had not occurred, that would have been enough gas to fuel a city the size of Red Deer and Lethbridge combined through a month of winter weather.

Initial attempts to control the blowout were prevented by the failure of equipment already in place on the well. So plans were

Gas escaping from the AMOCO wild well.©

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made to haul the rig off the hole and allow new equipment to be installed.

The well caught fire just when the rig was ready to be moved. After several days and a lot of hard work, a dynamite explosion which starved the fire of oxygen put it out. Then a new blowout prevention valve assembly was bolted into place at the top of the well. The valves were closed, and mud was pumped down the hole to close it up again.

Dave McAsey, Amoco's head of public and government affairs, said the company undertook steps to protect the environment shortly after the blowout. And the widespread environmental damage some people feared, he added, simply has not materialized.

There were two basic forms of environmental problems caused by the blowout--the immediate problems posed by condensate at the well site and in the Pembina River and the effects of hydrogen sulphide emissions.

To prevent pollution of the river, booms of straw were strung across the ice to contain any free-flowing condensate, while on the riverbank, trenches between 1.2 and 2.4 metres deep were dug to catch the yellow gunk. Finally, a system of dikes and culverts was installed downhill from the well site to catch condensate trapped in the snow that would ordinarily make its way into the Pembina with spring run-off.

Ron Findlay, Amoco environmental coordinator, said ice augers were also used to drill holes in the river to let any trapped gases escape.

Finally, the ice on the river was scraped to get rid of the condensate which, several weeks into the blowout, was layer-on-layer with snow. According to U Tin Tan of the municipal water supply branch, that method got about 50 per cent of the petroleum-based fallout but some managed to get into the watercourse at points where ice cover was incomplete.

An Energy Resources Conservation Board inquiry report into the blowout notes that the maximum concentration of hydrocarbons in water samples from the Pembina River was "in the order of a few parts per million." The report says this concentration would likely not have serious effects on aquatic life.

For residents downstream on the Pembina at Evansburg the presence of hydrocarbons was detectable by taste and smell. It meant a period when the only drinkable water in town came on the trucks hired by Amoco.

It was Christmas Eve of 1977 when the well caught fire. Flames quickly spread through the nearby bush of poplars and pine trees, laden with more than two weeks of flammable condensate. Small fires broke out here and there around the well while trees and brush close to the blaze were badly scorched.

The province stipulated any timber that could be salvaged be cut down. Trees too badly damaged were simply bulldozed and burned at the site. Amoco has already started to reseed grasses in the area and plans this summer to reseed with white spruce, said Findlay. He estimates the actual acreage of forest seriously affected by the blowout at probably less than 60. But as one provincial forestry official pointed out, it will still take half a century or more for the area to revitalize completely.

At one point into the blowout, there were several stories in newspapers saying dead moose were seen near the well while farmers downwind were complaining of horses bleeding at the nose. Findlay discounted both, saying there was so much seismic and drilling activity in the West Pembina area large game had left the area. As for the farmer complaints, all damage claims against Amoco have been dropped, he added.

Hydrogen sulphide that spewed into the atmosphere did not cause any long-term environmental damage, said Jerry Lack, head of the provincial air quality branch. "The effects are fairly local . . . hydrogen sulphide reacts with pollutants in the air and returns to the earth as salts. It's not like a volcano where dust gets into the air and never comes down."

That's not much consolation for anyone unfortunate enough to have been downwind. While the levels of hydrogen sulphide never came close to lethal levels, even minute amounts are enough to cause wrinkled noses. The tiny community of Lodgepole, the closest settlement to the well, was renamed 'Stinksville' at one point by a local trapper who remembered the original name of the hamlet was chosen to reflect the wholesome scent of lodgepole pine trees and mountain winds.

In Lodgepole, residents complained of nausea. Children were kept at home and three mothers left town on their doctors' orders, the stench got so foul. Paint on houses discolored with the odor but by and large, residents of the town said they've learned to live with hydrogen sulphide that occasionally drifts into town from the West Pembina fields.

Fortunately, blowouts are uncommon. (Amoco, for example, has had only three since 1948.) And they aren't inevitably devastating.

The ERCB inquiry report on the latest incident says that, though the blowout created "nuisance, anxiety and personal inconvenience from the odor," the release of hydrogen sulphide did not have any serious health effects on area residents. And, "except for the possible impact on the forest which has yet to be determined," there was "no significant discernible impact on the environment." Now the government and other agencies are working to ensure that future blowouts, if any, do as little harm.

Jack Spearman is a journalist in Calgary.

Gillian Sniatynski

Tree Power

10

There's more in the forests than wood.

With concern about fossil fuel supplies before us, and memories of a bitter Canadian winter behind, it's small wonder that government and other agencies are looking at alternative energy sources.

And small wonder that, in a country one-third covered by forest, renewable energy from the trees begins to look attractive.

Of course, wood is hardly new as a source of fuel. But there's more in the forest than wood.

By the process of photosynthesis, trees and plants capture the sun's energy and use it to convert carbon dioxide and water not only to wood fibre, but bark and foliage too. In theory, at least, the annual storage of energy in all this vegetation--known as forest biomass--could go a long way towards meeting our total energy requirements.

The technological task is to find ways to extract that energy efficiently and economically. So mill wastes, the 'slashings' left after logging operations, and whole new trees, all become grist to the new energy mill.

There are several processes by which energy is released from forest biomass.

The oldest and best known way is direct combustion--burning wood to get heat. But interest is growing in other processes, some still in varying stages of development.

Wood can be used in boilers to generate electricity. It becomes the heat source to produce steam, which in turn works the turbines that operate the generator. The town of Burlington in thickly forested Vermont converted one of its power plants to use wood chips. Other similar experiments are reported using hybrid poplar in eastern Ontario.

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Wood, too, is a source of gas. The gas is the result of a complex chemical process involving the application of heat to wood. The gas is 'low BTU' (British Thermal Unit)--this means its energy content is relatively low. Often it's an incidental byproduct in plants where the object of gasification is to produce a combustible material like charcoal. But the possibility exists that it could be used for energy too, like natural gas is used now, given the right economic circumstances.

Forest biomass can also be treated to produce methanol, a liquid fuel alternative which can among other things be used to replace gasoline in cars. The action of bacteria and enzymes breaks down the cellulose in the biomass to wood sugars, which can then be fermented to produce ethanol, a form of alcohol from which methanol is derived. And it could be that this form of 'tree power' will have the greatest future effect on Canadian consumers.

A 1978 feasibility study conducted for the federal government interdepartmental steering committee on Canadian renewable liquid fuels says Canada's forestry resources offer an 'immense' methanol potential.

The study notes that Canada's oil requirements are likely to exceed 700,000 barrels (111,000 cubic metres) a day during the years from 1985 to 1995. Methanol production could reduce that quantity by up to 220,000 barrels (35,000 cubic metres) a day by 1985, and by more than 550,000 barrels (87,000 cubic metres) a day by the early 1990s.

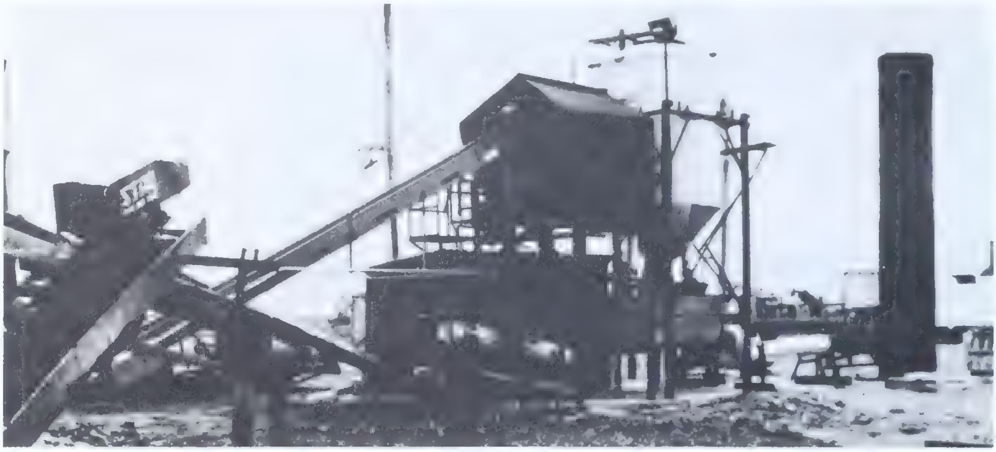
At present, forest biomass in all the ways it can be used accounts for about 3.5 per cent of Canada's energy, but its potential is much greater.

The Canadian Forestry Service, with the federal department of energy, mines and resources, last year established the Energy from the Forest (ENFOR) secretariat, as a funding agency to support projects aimed at realizing more of that potential. Special targets are means of maximizing the amount of biomass available and ways of improving its conversion to energy. The goal is to have eight per cent of the country's primary energy demands commercially available from forest biomass by 1985.

Even oil-rich Alberta is beginning to look at ways of making use of its great unused forest potential.

The Alberta department of energy and natural resources in 1977 commissioned a study to review current technology and apply it to the Alberta scene, to see how practical it would be to use the available wood for energy and chemicals.

The two major sources of wood fibre considered were the wastes generated by the wood products industry already in operation, and the huge unutilized aspen resource.



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*A plant in the United States which uses wood chips to produce gas.*12

Brian Karaim, forest products adviser for the department, notes that the study's estimate of Alberta's available energy from those two sources was equal to 24 million barrels (3.8 cubic metres) of oil annually. That's the equivalent of 76 per cent of the province's electrical energy requirements, or 37 per cent of the non-electrical.

But the business of realizing all that potential may be another matter, says the study.

It found that High Prairie, Slave Lake and Whitecourt had a big enough aspen resource to supply a large scale energy plant, perhaps a gasifier which could be used to produce charcoal and/or gas for energy. For a shorter time period, so did High Level, Manning and Lac La Biche.

But compared to coal, wood as an energy source currently doesn't fare too well. The study notes that in most cases, coal can be delivered to power or gasification plants much more cheaply than can wood or wood wastes.

Karaim concludes that wood right now can only be considered an economical source of power and heat in special circumstances.

At High Level, for example, there are large amounts of wood waste available, a fairly heavy demand for heat and power, and no other cheap fuel at hand. (High Level currently uses propane for its energy needs.)

Though the economics of forest biomass energy are not too encouraging, time and the reduced availability of fossil fuels may change that. And the department, like other agencies concerned about energy, isn't waiting for an energy doomsday before it takes action.

As an example, it has called for tenders from Alberta companies for proposals on tapping energy from sawmill wastes, which are now generally burned off. That sends about 6.6 trillion BTUs up in smoke every year--more than twice the annual amount of energy used by the province's 24 biggest sawmills.

But if economics are against it, the use of forest biomass as an energy source has environmental benefits in its favor.

Dr. K.O. Higginbotham is assistant professor in the University of Alberta's faculty of agriculture and forestry, department of forest science. His areas of special interest are forest ecology and tree physiology.

He notes that, like anything burned for fuel, forest biomass combustion releases carbon dioxide.

Concern has been expressed about amounts of CO_2 in the atmosphere, but it's a concern Higginbotham thinks may be exaggerated. At least in terms of plant production, he says, increases in atmospheric CO_2 have done nothing but good, because plants use CO_2 for photosynthesis.

The big plus for forest biomass combustion, however, is that it doesn't give off sulphur, which makes it much cleaner than gas or oil. Neither does it pose problems in terms of noxious waste disposal. The 1978 feasibility study on liquid fuels states that air, water and other pollutant impacts from methanol conversion would be minimal, and that methanol as an auto fuel is much cleaner-burning than conventional gas.

13 LAURENDALE

Of greater concern are the effects on the forest environment of increased logging, and perhaps of new methods of forest biomass 'harvesting'.

Imagine a large-scale 'tree plantation' with heavy machinery along the lines of combines to do the harvesting, and, says Higginbotham, there may be serious reason to worry about environmental damage.

But he foresees a different scenario for Alberta.

With the ultimate aim of maximizing our forest biomass potential, he's now involved in a study of aspen growth--aspens because, comprising 80 per cent of the province's deciduous hardwoods, they're "the obvious choice" for development.

His study will seek to determine how quickly the aspen resource would be depleted by harvesting, what effects more frequent harvesting would have on soil nutrient levels, and so on.

In Alberta, aspens are underused. And since forests need to be regenerated in order to survive, there's evidence to suggest that more frequent cutting could be a benefit.

Then, says Higginbotham, aspen costs almost nothing to regenerate, and regeneration is easy. "I think there is no species that offers quite the ease of management, so it's more difficult to make environmental mistakes."

Since most of the cutting would be done in winter, the leaves would be down on the ground, and remain as a valuable source of nutrients. Also, there's enough aspen available to make cutting the same place more often than every 40 years probably unnecessary.

The drawback of increased logging for energy is the same as for any logging. Roads must be made through forested areas, skid trails cut for dragging logs. And over it all, the roar and whine of big trucks and chain saws would shatter ages of silence.

At least, though, says Higginbotham, ours are mostly flat, boreal forests, where the roads and skid trails are less likely to cause erosion damage than in more mountainous areas.

He definitely sees the Alberta of the future making much more use of wood for space heating and power in its smaller northern communities. He sees residents of the big urban centres like Edmonton and Calgary making increased use of methanol in their cars.

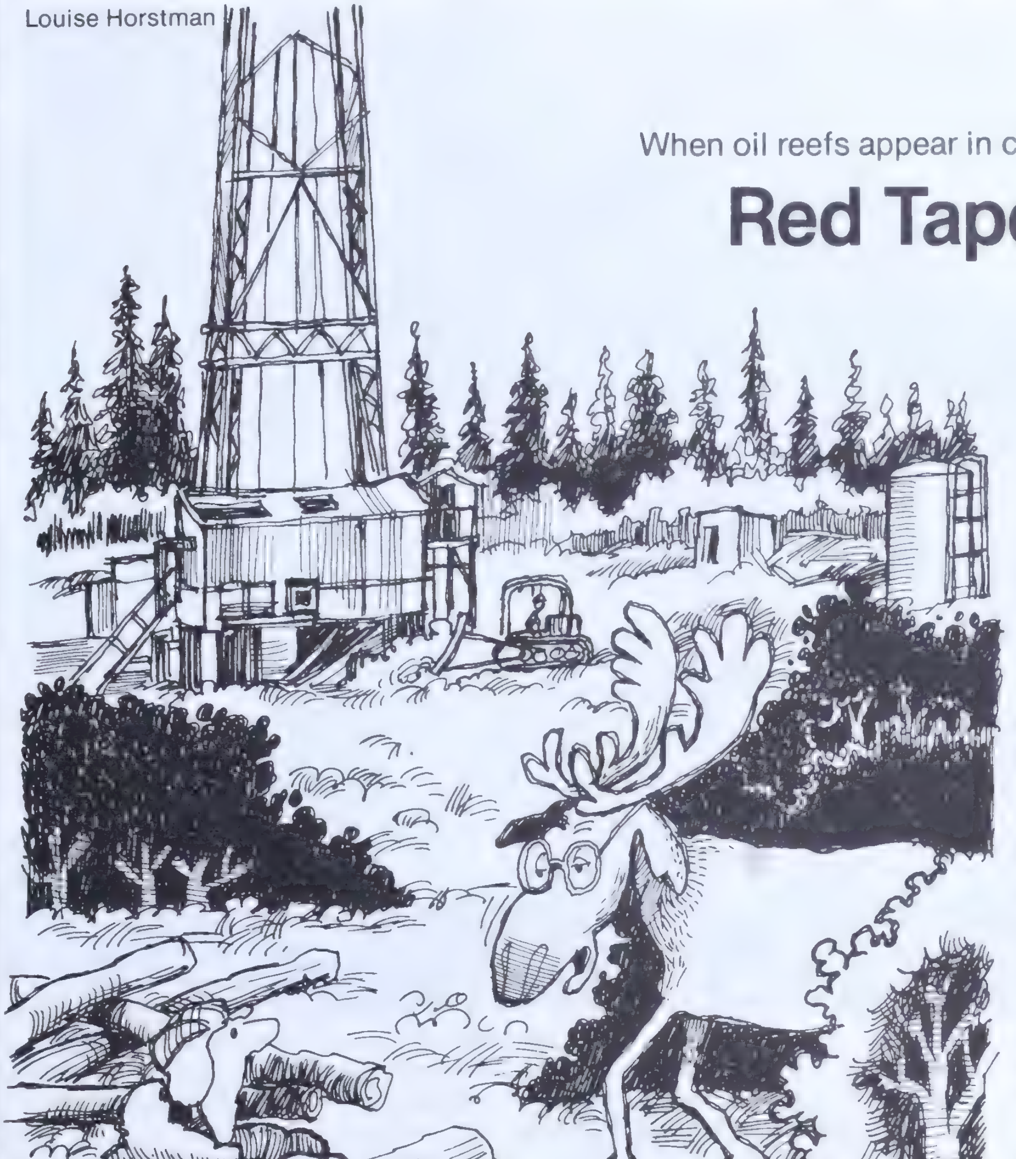
And he thinks the province is in "a happy situation environmentally" for making it happen.

Gillian Sniatynski is a freelance writer in Edmonton

Louise Horstman

When oil reefs appear in critical wildlife zones, it's a

Red Tape Tangle


Don't get up gents...I'm just having a look.

An oil company manager with a crew operating in the West Pembina region tells of a moose that visited the oil rig in December.

"We didn't know whether to serve him coffee or tea," he said.

That was obviously a friendly visit!

But there are more thorny questions to be answered in other situations where industry and wildlife come together.

Alberta's West Pembina district, midway between Edson and Rocky Mountain House, offers many examples.

The area is one part of the Eastern Slopes region, which was the subject, in July, 1977, of the provincial government's long-awaited document on resource management.

Aimed at establishing priorities for future land use, it divided the region--all 92,000 square kilometres--into zones, certain of which were specifically intended for the protection of wildlife.

The 'critical wildlife zone', sweeping along the Pembina, Nordegg, Elk and Brazeau Rivers, contains valleys, meadows and flood plains important to the elk, moose and deer of the surrounding areas, particularly as winter range, but also as migration routes and perhaps calving areas.

But oil reefs are not respecters of critical wildlife zones. In the fall of 1977, Chevron hit oil in the West Pembina, and the rush was on. During the following year, nearly 100 companies moved in. To date, 500 million barrels (about 80 million cubic metres) of recoverable crude oil reserves have been found there, making it the most significant crude oil field discovered in Canada in the past 15 years.

So what about the wildlife? In a critical wildlife zone, it must come first. Petroleum and natural gas exploration and development are allowed, but on a restricted basis.

It's on the subject of restrictions that the controversies begin.

Before a company can begin exploration in a critical wildlife zone, it must purchase a five-year lease on the mineral rights. Once it has the mineral rights, it must then apply

ALBERTA GOVERNMENT PHOTO

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for a permit to construct access roads, wells and pipelines. These permits come with strings--and sometimes the strings get tangled.

One tangle involves restrictions on the timing of seismic and drilling activity.

Under a heavy snow cover, only limited areas of forage and browse are available to elk, deer and moose. In order to avoid disturbing them in critical wildlife areas, the Fish and Wildlife Division has often asked that work cease there between January 1 and April 1. The alternative, for the oil companies, would be summer work.

But much of the West Pembina is muskeg and coniferous forest. In summer, tracked vehicles on seismic trails make ruts which soon fill with water and make the revegetation required by the Alberta Forest Service difficult. Also, when the muskeg gets too wet, extra roads must be built to skirt the wet section of seismic lines. The Forest Service would prefer that exploration be conducted in winter, when the ground is frozen and protected by snow cover.

Roads also become rutted in summer from heavy use. Soil runoff from roads and seismic lines may result in sedimentation and silting up of streams and gravel beds vital to developing fish eggs. Hence water quality and fisheries biologists also prefer winter for drilling and seismic activity (though this concern is less extreme and timing arrangements with wildlife authorities can be worked out).

So what are the oil companies to do?

For most of them, the issue is not whether summer or winter activity is preferable, but the fact of having to stop work part-way through an operation. Sometimes bad weather leads to delays and work isn't complete by the seasonal deadline.

Cost is a factor. Moving a seismic crew of 40 or 50 men and 10 or 12 trailers out of one area and into another, with a return move in the spring, costs from $10,000 to $100,000. Then there's the question of safety. A well can't simply be abandoned--it must in effect be plugged up if it's to be left for any length of time, to prevent gas migrating to the surface and causing dangerous leaks or blowouts.

More than one oil company representative has also objected to the winter work restrictions in areas where, they say, there are no significant numbers of wildlife anyway.

That's quite possible, says Mike Bloomfield, regional wildlife biologist at Edson, in whose region West Pembina falls.

He notes that one or two aerial surveys during the winter--even for a couple of winters--don't always give a good estimate of the amount of big game in an area. If snow conditions vary from one winter to the next, animals will move. And if the winters are mild, as the past two have been, they will range much more widely.

Animals' adaptability must also be considered. Some species adapt to certain levels of activity, especially if it's of a recurring nature and doesn't harm them. But elk are one of the most sensitive big game species. According to Dr. Valerius Geist of the University of Calgary's faculty of environmental design, elk will withdraw from about 225 to 350 metres from the edge of a road with heavy vehicular traffic. So twice this expanse of habitat may be lost for every heavily-used road put through elk range.

The intensive work by the oil companies in the Eastern Slopes has created many problems for the Fish and Wildlife Division.

As Dave Neave, the division's director of wildlife, points out, no increase in budget or manpower was provided for the extra work needed. So manpower and funds had to be diverted from other objectives into the detailed survey and mapping of wildlife habitat and distribution in the critical wildlife zones, and surrounding zones.

It was also necessary to check out in the

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*Young moose.*14

How effective will this gate be in barring access to an oil company road? 16

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field hundreds of road, wellsite and pipeline referrals in 1978, as well as proposals for siting of seismic lines, access roads, trailer camps, and transmission lines. The loss of the division's two wildlife biologists for the Edson region in a plane crash in February, 1978, was a great setback.

"If there was some master plan for the roads and utilities going into the area, the workload would be considerably lightened for us," Neave said. "But all is planned in piecemeal fashion."

The division also comes into conflict with other interests when it comes to road closure, another restriction designed to protect critical wildlife areas.

The division wants all new company roads blocked at their point of junction with permanent roads. It has asked that locked gates be installed while the roads are in use, and that logs and debris be piled up to make them inaccessible once they are no longer needed.

The object of the road blocks is to prevent decimation of big game populations by hunters having easy access to them, and to prevent harassment of game by snowmobilers.

But the Licence of Occupation regulations governing the construction of such roads under the Public Lands Act requires that they be open to the public. Fearing a change in the regulations, snowmobile associations last year mounted a successful campaign to have the roads kept open.

The Forest Service also wants them open to make firefighting easier. If the hunting pressure becomes too heavy, asks one forestry official, why not further restrict or even close hunting in the area?

This is being done, but it's a slow process. The cow elk season is now greatly reduced in the West Pembina area.

But hunter kills in the area are up--and the major oil companies are not necessarily to blame. Most are extremely particular about restricting weapons use by their personnel, and on some roads they've posted signs prohibiting illegal hunting or harassment of animals. Edson biologists attribute the bigger kills in part to the small contract crews operating their own trucks with two-way radios and rifles in the cabs. But the public is also responsible.

According to William Wishart, section head of wildlife research for the Fish and Wildlife Division, the presence of oil crews may even be a deterrent to illegal hunters. He says we may need some 'game guardians' in the West Pembina once the crews pull out. And, he adds, paying for them should be part of the cost of constructing the roads in the first place.

Another wildlife concern is the problem of increased harassment resulting from the increased access to animals which the oil roads have offered.

In winter, a big game animal's 'energy budget' can run quickly into the red when a snowmobile gives chase. This kind of harassment could spell the difference between calving or not calving in the spring, or even between survival and death, depending on the animal's health, and weather and snow conditions. According to Dr. Geist, moose forced to undergo heavy exertion in cold weather are often prone to a fatal attack of emphysema.

Elk can die as a result of a short, intensive pursuit by helicopter, and although studies involving snowmobiles are not available, the same result is probable, says Dr. Ron Lewis of Alberta Agriculture's veterinary services division.

And Dr. M. Dorrance of Alberta Agriculture found that snowmobiles, not giving chase but simply using trails through white-tailed deer territory in Minnesota, caused the deer to abandon all or part of their home territories--a harmful result, especially during a severe winter.

The problems seem endless. And often, ironically, the villain of the piece is not the oil company. Several fish and wildlife administrators comment that the difficulties are as much the result of conflicting interests among different branches of the government.

These are conflicts that the petroleum industry would like to be removed from. Several major oil companies, including Amoco, Esso and Mobil, would like to assume a broader role in setting their own environmental standards in the Eastern Slopes. They're in the process of setting up a task force to work with the government with that end in view.

Certainly until the conflicts are resolved, the problems in the critical wildlife areas will remain.

Louise Horstman is a freelance writer in Edmonton

Sharon Adams

Who Can Catch the Sun . . . and Wind?

Sun-power and windmill buffs are being joined by an increasing number of governments and businessmen.

'Let the sun shine in' is becoming a catch phrase in an energy-starved world--and even in energy-rich Alberta a small group of environmentalists, conventional energy companies, businessmen and private citizens are intent on capitalizing on the solar system's biggest source of energy--Old Sol himself.

While experts agree solar power is not the only answer to meeting the energy needs of the world once the crunch really hits, many believe it will be an integral part of the system used to keep Earth's inhabitants from freezing in the dark once the oil wells stop pumping and the coal veins run dry.

The United States government is devoting half a billion dollars, with more to come, for solar and wind energy research so the country can reach its goal of supplying 25 per cent of its energy needs by the turn of the century through these alternate means.

Canada is following in its southern neighbor's footsteps, with the federal government pumping $380 million into solar and unconventional energy development over the next five years. The National Research Council has doubled its solar energy research budget each year since 1975.

But in Canada, one province has been doubly blessed. Not only does Alberta have the major proportion of the traditional energy sources--oil, gas and coal--enough to last us well into the next century, but the three sunniest spots in Canada are found within our borders and our proximity to the mountains ensures an abundant and strong wind source.

In 1976 the federal and provincial governments set up the Energy and Resources Research Fund (ERFF) which will at the end of its five-year life have invested $96 million in Alberta research supporting development of new or improved technology for recovery, production and conservation of fossil fuel energy resources and development of renewable energy sources.

Through ERFF the governments are prepared to substantially underwrite application-oriented research, retaining rights to techniques developed to ensure their availability to the public.

R.D. McDonald, manager of research projects for the provincial energy and natural resources department, which administers ERFF, recently told a meeting of the Calgary Solar Energy Society that "one of our biggest problems is just getting good, well-thought-out projects" to support.

This could be one explanation of what is seen by some as a bias in the ERFF program in favor of conventional energy resource funding. Although $96 million will eventually be available under the program, only $2,817,065 was spent to the end of March, 1978 on 14 projects. Solar and wind energy research accounted for only $174,604 of the spending, compared, for example, to $365,000 on enhanced recovery of conventional oil.

The single largest alternate energy research project in the province is the ERFF-supported Solar and Wind Energy Research Project (SWERP) in Edmonton. Established two years ago under the leadership of Dr. Terry Rachuk, SWERP has developed an extensive collection of data, available throughout the province under an interlibrary loan plan, on alternate energy projects. SWERP has also set up four monitoring stations, with three to follow this year, to measure the amount and best sources of solar and wind power in the province.

Dr. Rachuk says SWERP's data collection is a necessary first step towards a sensible approach to energy exploitation. He calls it energy budgeting, and says it's much like balancing a cheque book before deciding on a major purchase; you simply find out how much income is available before determining how much and on what that income will be spent.

One of SWERP's first reports, Wind Power in Alberta, is an 80-page booklet packed with information on the feasibility of windmills. The booklet notes that while electricity from wind power is currently an expensive alternative to conventionally-produced power, "decreasing fossil fuel reserves and the promise of steadily increasing conventional energy costs may change this."

The booklet gives wind power enthusiasts information on wind velocities throughout the province, what companies are doing research and which are producing windmill hardware, and even has tips for the do-it-yourselfer.

Dr. Rachuk says the establishment of the seven monitoring stations throughout the province will increase the body of knowledge on supply of wind and solar power.

Still, SWERP is only one project, a mere flicker in the darkness, and alternate energy advocates say much more could be done. Primarily, critics of conventional energy exploitation practices have three major beefs.

Firstly, they say, because Albertans happen to be sitting atop one of the country's biggest natural resource nest eggs, government and industry are unwilling to fly out in search of alternate energy.

Secondly, they claim energy budgeting has not been done on major conventional energy projects, and wonder if we could be expending more high-quality energy to extract and refine other energy forms than we are ultimately gaining.

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And finally, the public is woefully ignorant of alternate energy sources and sadly misinformed of their practicality and how, once in wide use, they could alter our lifestyles.

For instance, they say, too much publicity has been given to the fact that active solar energy heating systems and wind energy electrical generators are not yet cost-effective in Canada; the efficacy of passive solar energy systems and the benefits of active solar and wind energy in remote areas have been largely ignored.

Teng Lee, chairman of the Calgary Solar Energy Society and a University of Calgary environmental design faculty member, says cost-effectiveness of active systems is a red herring thrown into the argument for development of alternate energy sources by those who see a continuation of the status quo in energy exploitation as beneficial to their interests.

For although "it will be years before an active solar energy heating system becomes viable in Alberta," passive systems, which use no moving parts and are largely constructed out of materials easily at hand and in wide general use, are already able to make substantial savings in fuel expenditures--even to individual home owners.

"We have a false sense of security about our conventional energy sources," he says. "The gas prices we pay are artificially low because they are subsidized by the government, but the government can't afford to maintain such low rates indefinitely."

He predicts the skyrocketing prices of conventional energy will cause interest in alternate energy to soar. Although active solar energy heating systems now can cost anywhere from six to 10 times more than conventional heating systems, the margin will shrink, as it already has in places like Prince Edward Island, where the cost of servicing and delivery of other energy types has reduced the relative cost of active solar systems to just twice that of their conventional counterparts.

There is an even more drastic cut in the difference of costs between the two if passive, rather than active, solar energy components are employed.

Solar energy reaches the earth as ultraviolet rays, infrared radiation and visible light. The amount of solar radiation available at any place depends on the latitude and cloud cover, which is why Alberta is in such a favorable position for developing solar energy alternatives. At the coldest time of the year when there is the greatest demand for thermal energy, Alberta experiences its most cloud-free and brilliantly sunny days.

Solar radiation can be put to use to heat water and air by two methods. An active solar system uses a mechanical system to transfer heat absorbed in solar collectors (usually plastic panels, greenhouse glass or skylights) to where it's needed through a system of copper tubing. Hot water is pumped to a storage compartment, where it can be circulated to produce heat or for domestic hot water.

A passive system uses natural convec-

*A parabolic dish solar collector which powers a motor.*19

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tion, the simple flow of warm and cool air. Here, placement of windows is all-important.

But the most important feature of both systems is insulation to keep the heat produced from every source. Doors and windows must be very well sealed, walls, ceilings and basement floors well insulated, and as much protection as possible afforded to areas away from the sun to prevent chilling by the wind and shade.

In Alberta, most houses containing an active solar system were built experimentally and at great cost, for active systems can cost up to $30,000, depending on the elaborateness of built-in controls. Some enthusiasts have substantially cut that cost by building their own systems and keeping them very simple; a collector, pump and storage tank are all that's really needed.

Passive solar heat is used in many places, and virtually everyone can adapt existing homes to take advantage of the sun. An Ontario Ministry of Energy brochure on solar heat mentions several guidelines for using passive solar energy.

"A house designed with passive solar heating in mind has large recessed windows facing south, an overhang that allows the solar radiation to penetrate during the winter but shades the house during summer mid-day hours, earth banked on the north side of the house to reduce its exposure, trees that lose their leaves planted on the south to provide shade in summer and allow the sun's rays to penetrate during the winter."

Houses built now with these features can take advantage of passive solar use, and will be in a better position for conversion to active solar heating when the time comes. Dr. Lee laments current building practices which ignore these guidelines. "Most of the housing now existing or being built is already obsolete."

Dr. Lee is currently working on a design for the Chinese Alliance Church in Calgary's Beddington Heights. With more than 3,000 square metres of space to be heated, Dr. Lee expects his passive energy system will supply half the church's heating needs, reducing the monthly heating bill from $1,000 to $500--a substantial saving.

A small active solar heating component, to be installed through volunteer labor (the cost of labor is a major cost in an active system) will substantially cut down on the expense of heating water, perhaps by as much as 80 per cent.

Solar energy activist Michael Kerfoot praises the simplicity of the solar alternative: "There's nothing that can beat just putting a window where it belongs and letting the sun come in."

He, too, is concerned about the wasteful design of Canadian housing.

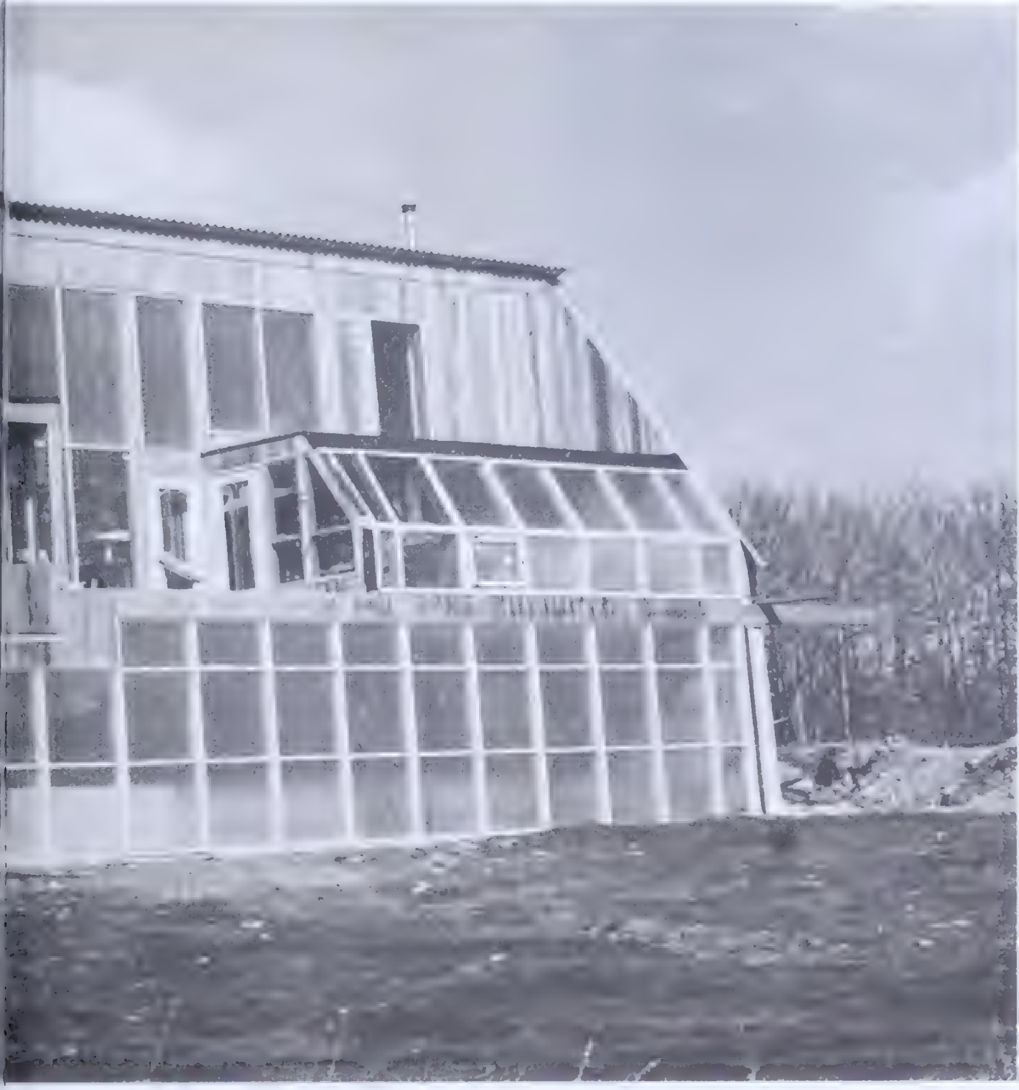
"We build California ranch-style houses in an area where igloos belong."

Dr. Kerfoot, who with colleagues Jorg and Helen Ostrowski, recently won two prizes at the Solar Olympics in Edmonton for best innovation and best solar house design, have designed a passively-solar heated house (now occupied) which they believe can derive its total heating needs from the sun.

It employs the principles of convection but has some added features: extra-thick walls for added insulation, a pie-shape with elevated front so the amount of sun entering from the south is proportionately larger compared to the space it will heat; heat-hugging wall and floor materials, transoms and cathedral ceilings so each room can be lit by the sun and store heat in ceilings, floors and walls; a greenhouse; and a basement with southern wall next to the solar panels lined with oil barrels filled with water, which will absorb the heat and store it for continual use. Finally, a solar 'curtain' to protect window areas from the night chill and winter blasts.

But solar activists and governments aren't the only ones investigating alternate energy--businessmen, too, are exploring its possibilities. Space limitations allow only a brief mention of a few of these projects, including:

- Algas Resources, a subsidiary of Alberta Gas Trunk Line, which has given a $20,000 grant to a University of Calgary researcher developing a prototype of a verticle axis windmill. Under the arrangement, the university will hold the patent, but Algas will have the first right of refusal on development. Spokesman Ken Montgomery, the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*Solar-heated house belonging to Winnie and Howie Robertson, about 20 kilometres west of Carstairs.*20

*Geodesic greenhouse.*21

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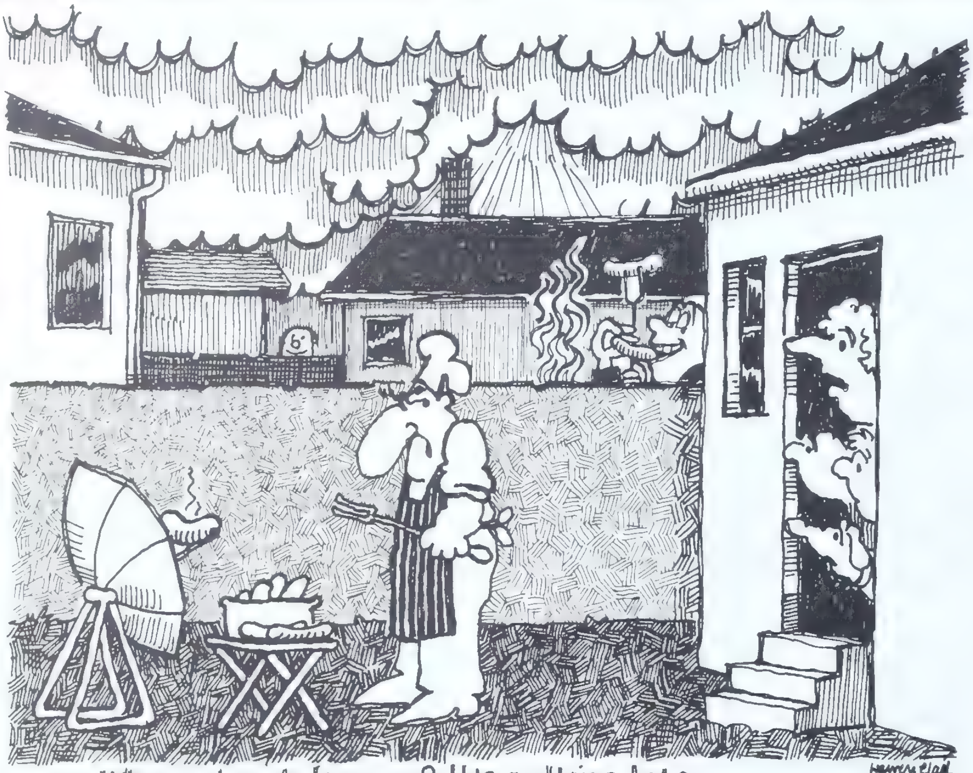
company's representative at the Calgary Solar Energy Society, says "we can't close our eyes" to conventional energy's future, and says Algas is hoping to develop the windmill for export, particularly to developing nations with no energy resources;

- Frank Meriwether, Calgary architect and businessman, installs active solar heating systems for use in swimming pools and hot water heaters. He says the average household uses between $8 and $15 of energy in hot water heating bills monthly and an active solar heating component can eliminate 70 to 85 per cent of the cost, for an initial investment of $1,200 to $2,500. Although the initial investment seems large, the system will easily pay for itself over its 20-year lifespan;
- Calgary's Gulf Canada Square, with more than two million square feet (186,000 square metres) of space, will have no interior heating system. Instead, it will capitalize on all sources of heat--that streaming in through the windows, built up from body heat of its inhabitants, and produced from machinery and lighting. It also is well-insulated and employs a computer system for distributing heat throughout the structure;
- Olympia and York's Esso Plaza, an $80 million, 33-storey building in Calgary's core, will use an active solar system to heat water for use of the 1,000 employees expected to work there;
- The Bill Boucock Partnership, architects, are designing an Alberta Housing Corporation-supported senior citizens lodge near Pincher Creek which has active and passive components expected to supply 70 per cent of the total energy required for heat and water;
- W.B. McPheeters is marketing manager for Data Acquisition Systems, which installs photovoltaic cells for producing electricity directly from solar light in remote areas where the need for power is minimal but the location is difficult to service through conventional means. In these cases, the far north or the top of mountains, the relatively expensive method of producing electricity is the most economical.

The Redcliff town council has officially endorsed a proposal to establish an "alternative forms of energy research network" which would cost a minimum of $25 million. Medicine Hat's economic development committee has endorsed it and agreed to a feasibility study.

Project manager Roger Breault says the two councils should approach the provincial government for financing from the Heritage Savings Trust Fund to make the area a solar energy showcase.

The ultimate aim of the project is to ensure Albertans continue to be energy self-sufficient and he hopes to attract a solar energy industry to the area, including a greenhouse industry, solar and wind projects for producing heat and electricity, construction of a greenhouse conservatory heated by excess industrial heat, construction of



When's lunch honey? It's getting late.

solar kilns for use in the local ceramic and glass industries, export of solar technology and conversion of housing to take advantage of solar heating.

Suffield, Medicine Hat and Redcliff are Canada's three top contenders for sunshine capital. Medicine Hat receives about 2,300 hours of sunshine each year.

Breault says the local councils would have to agitate for legislation which would provide the populace with incentives for converting to solar energy.

Incentives would include legislation enabling the municipalities participating to recover personal taxes from solar energy home improvements for use in promotion of the idea, for grants to homeowners, farmers, apartment buildings and institutions for installation of renewable energy devices and incentives for homeowners much the same as those now enjoyed by developers and builders who can write off certain construction and installation costs against income tax.

Although there is increasing evidence solar and wind energy will become economically viable, even necessary, adoption of these alternate energy source projects will mean wide-scale changes in the human environment.

The first adjustment will be in energy attitudes. Use of both solar and wind energy systems requires a certain amount of participation by the consumer. It will no longer be enough to simply plug in a cord or switch on a dial. Passive solar energy users must give daily attention to their systems, opening and closing draperies, blinds and shutters to admit sunlight or shut out the dark, a blizzard or cloudy day.

Since electricity produced from windmills can be stored in batteries, and since technology does not yet exist to make a battery able to store all the energy produced, care of the storage system is important.

The human landscape will indeed change. Construction and development industries will have to do an about-face. Housing designs now favored, ranch-style, sprawling homes with windows everywhere but not necessarily where they'll do the most good, will have to be abandoned. More thought will have to be put into designing homes for the environment which they'll occupy.

Homeowners may have to adjust to greater fluctuations in temperature. Dr. Lee points out that a furnace works at peak capacity only after it has warmed up, so it makes sense to have a temperature regulator installed in the furnace system using conventional energy so the motor will run longer. He suggests an eight-degree variance, with the system kicking in when the heat falls to four degrees below optimum temperature, and turning off when the heat reaches four degrees above optimum temperature. Donning and doffing sweaters may become a way of life.

Our landscape will change. Houses will have thicker walls to accommodate extra insulation. Solar houses should face south and west, not north, so the current grid pattern of streets will eventually be outdated, or homes now facing north will be renovated so activity rooms--living rooms, dining rooms, recreation and family rooms--will be closest to the source of energy.

Laws, too, will need changing. Zoning regulations will have to ensure equal access to the sun, and that will likely mean height restrictions. Sun rights legislation will also be necessary. The United States and Japan have both recently adopted such regulations: in Japan, owners of buildings with long shadows have to pick up the tab for the difference in their neighbors' heating bills.

Windmills will present special problems. The bigger they are, the better they operate, so neighborhood sharing would be ideal, but upkeep and access agreements would be necessary. Since windmills are noisy, there would have to be some thought given to noise attenuation and the distance required to baffle the sound. Also, the very power upon which they rely is also their greatest threat; windmills have been known to lose pieces or even topple in forceful gusts, so liability insurance and safety equipment will be necessary.

Large-scale use of either type of system will create special concerns as well. Solar ovens--huge solar collectors to provide warmth or energy for a city--take up lots of space, as would transmission lines and access roads. Interference in migratory habits of wildlife would be a concern. Large windmills create larger noises, and may affect animal life.

And finally, large-scale use of alternate energy sources will force us to do some thinking about how we'll use the remainder of our conventional energy.

Dr. Kerfoot believes the best solution is to limit or specify use.

"We're not against using the non-renewables (conventional energy sources). We're just against burning them up, wasting them. If we're going to spend a barrel, we should use it to produce a barrel of something besides pollutants. Why not make a barrelful of useful plastics instead?

Sharon Adams is a journalist in Calgary.

Richard Finnegan

In Search of Oil

"If a seismic crew is sloppy in its work, the whole industry suffers."

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Seismic testing can roughly be equated to radar or sonar activity.

But instead of bouncing energy waves through space or underwater to detect uncharacteristic objects, seismic shocks usually are sent underground in search of oil.

There are refinements and variations on the theme, but basically an anomaly detected by the delicate instruments charting the wave can indicate the limestone 'dome' which is a good indication of oil or natural gas to the trained geologist.

Most formations cover a bed of sand and are surrounded by shale. When a test charge is fired, the shock wave penetrates to the sand bed and returns. If it should pass through limestone it will do so at increased velocity over the surrounding shale.

Consequently the shock wave will be detected more quickly by the instruments, regardless of the fact that the distance to the sand and back was the same.

Voilà. Oil. Perhaps.

Robert Ferguson is well acquainted with the procedure. He's been 'shooting holes' in Alberta since 1947.

He is president of Canseis Lines Ltd., one of more than 100 small companies specializing in seismic operations in Canada. Eighty of those companies are found in Alberta.

Two chain saw crews, he said, are assigned especially to clean up the lines required for the seismic operation, but not necessarily because of recent regulations of the Alberta Department of Energy and Natural Resources.

"I've been in this business a long time," he said. "So far as I can remember, we've always done a pretty good job at cleaning up after our operations and we've always filled in our holes."

Ferguson said he can remember visiting rock piles for stones of the right size to tamp down the holes once the tests were complete.

If he has any single complaint with the conditions imposed on his and other seismic operations, it may be in the added costs of cutting and piling all timber of marketable size.

"We wouldn't mind except we know most of this stuff is just left in the bush. None of the bigger timber companies is interested in it because it's so far back in the bush."

Regardless, Alberta Regulation 423/78 is a strong tool in the hands of the exploration review branch of the energy and natural resources department, regulating what once was a comparatively wide-open scene.

"We're far from being public relations men out there," Branch Director George Fulford said of the 12 inspectors who now assess operation and cleanup of every seismic line in the province.

"There was a time, and it wasn't too long ago, that the chances of being checked were not very great. But all that has changed with the number of inspectors and regulations that have teeth in them.

"We're in the field now to police the regulations in a reasonable but firm manner."

Several aspects of the regulation, including its provision for suspension of permits and licences, and the sections stipulating penalties and fines, now are much more stringent than in the period before the regulation came into effect late in 1978.

Generally, the regulation requires that seismic crews fill their blast holes, pick up wire and garbage, and keep their seismic lines at least .8 kilometre from the banks of a major river. Only one major stream crossing is allowed.

Its main requirement, however, is that conditions for individual seismic operations must be agreed to by an applicant before he launches a specific project.

"It used to be that an operator got a blanket licence to operate in the province and the only way in which you could pull a permit would be if he were operating in a manner that was a threat to life and limb," Fulford said.

"If the cleanup work is done on the spot, I don't feel it adds that much to the costs of operation. When we negotiated these regulations with the industry, no one hopped up and said it was going to cost a fortune."

Regulation of the seismic activity in the province had to come, he said, to curb a growing list of complaints about industry activities.

"Municipalities especially would claim damage against companies for disruption of roadways," Fulford said. "The result would be an argument between the company and the municipality over whether the damage actually was caused by the company's activities. Our mandate now gives us the power to arbitrate all disputes."

The regulation has not seriously affected the activities of another Edmonton-based company, Silver Tip Drilling.

"I think it's a heck of a good move and it doesn't hinder or make our operations more expensive at all," said company President Gary Frostad. "Any activity such as this, which must largely be conducted on public or private lands, should be subject to stringent regulation.

"If everybody got to do things in whatever sloppy fashion he wanted this would be one heck of a fine looking province, wouldn't it?"

Energy and Natural Resources has been using its new clout effectively to shut down untidy operations in the province and has received a great deal of support from the oil industry.

"To the man on the street, all oil industry activity is tarred with the same brush and if a seismic crew is sloppy in its work, the whole industry suffers," Fulford said.

Richard Finnegan is a freelance writer in the Edmonton area

Peter Morton

Growing Pains

Two resource-based towns look past their rocky beginnings to the future.

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Many of the townspeople of Fort McMurray gathered eagerly in the hot sun on Dominion Day, 1965, to watch the provincial highways minister, flanked by officials of Great Canadian Oil Sands Ltd. (GCOS), cut a ribbon to officially open a 500-metre bridge linking Fort McMurray to the Athabasca Tar Sands.

This was the beginning. What started as a pipe dream back in the 1920s had finally become a reality. Fort McMurray, whose population back in 1965 had doubled in four years to 2,000, was on its way out of anonymity.

With the prospect of nearby oil sands development, Fort McMurray asked for, and received, the provincial government's 'new town status,' thereby ensuring government funds and expertise to help guide the community through what the town elders accurately predicted as a 'boom era.'

Despite difficult technical problems with extracting commercial-quality crude from what it really was--tar sands--the optimism of GCOS had convinced the town and the province that, sooner or later, the process would be cost-effective.

Canadian Bechtel Ltd.--which would later do much of the work on the Syncrude project--was hired as general contractor for GCOS, and quickly contributed 4,500 construction workers to the town's population, which burgeoned to 8,000 by 1966. The town was eight kilometres long, three blocks wide, dusty in summer, cold in winter.

Meanwhile, nestled in the grasp of some of Alberta's most beautiful wilderness, lay the hope for yet another town. Coal would be to Grande Cache what the oil sands were to Fort McMurray.

McIntyre Porcupine Mines Ltd. had a $450-million, 15-year contract to supply Japanese industry with nearly two million tons of coking coal a year. The company hatched plans to develop what it saw as a vibrant new community, complete with shopping centre, hotel-tavern and at least 165 single-family homes.

By 1972, nearly 4,000 people had moved into Grande Cache, which also had been assigned new-town status but was still without a paved road to Edmonton or nearby Hinton. Even then, problems were starting to come up. Housewives, protesting against the high prices in a local store, opted for the 110-kilometre round trip to Hinton. Single, transient workers flooded the town.

While the one-industry towns of Grande Cache and Fort McMurray opened up opportunities for jobs and increased resource wealth to Albertans generally, the sudden influxes of people also presented a range of social and servicing problems.

To the fortune-seeker, Fort McMurray appeared to have the best opportunities to make a buck. So, while Grande Cache was struggling with its high food bills, the residents of Fort McMurray were starting to voice what would be the cry for years to come: 'speculators.'

The town had experienced one dramatic building boom in the late 60s, associated with the GCOS development. Now a few years later, here was another land scramble, this time in conjunction with the proposed $650-million Syncrude Canada Ltd. plant.

Between 1969 and 1972, raw land prices in the oil sands town more than tripled. Housing prices soon outstripped those of Edmonton, 450 kilometres to the south. A

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house that would sell in Edmonton for $25,000 was priced at $37,000 in Fort McMurray.

Irate mobile-home owners, packed into a treeless tract of land just outside of town, threatened to drag their homes downtown and block off the entire town if they couldn't persuade someone to break up the speculating boom.

There were environmental considerations other than housing too. In 1973, Eugene Kupchanko, the Alberta government's assistant deputy minister in charge of the environment protection service, said that $8 billion in direct capital investment would pour into the area, and, with it, massive environmental and ecological complications.

At a press conference announcing upcoming northern environmental studies, he calculated that 20,000 acres of forest would have to be cleared, billions of cubic metres of dirt moved, and paths cleared for pipelines to move the first dribbles of the 300 billion barrels of oil trapped in the sand.

Syncrude got the green light in September, 1973, and, explained then-town chairman Chuck Knight, "actually it is all very anti-climatic."

Knight, with others, had already envisioned the social problems stemming from the massive plant's construction. What housing was being built was already oversubscribed, and he foresaw men receiving big salaries and "breaking up the bars on Friday night."

Grande Cache was having problems of its own. In October, 1972, there was a work stoppage at both of McIntyre's mines; the company claimed it resulted from disciplinary action it had taken but the miners denied this, complaining of unsafe working conditions in the Number 5 mine.

Determined to reduce costs, McIntyre decided early in 1973 to close that mine, re-

ALBERTA GOVERNMENT PHOTO

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sulting in the layoff of 206 skilled underground miners, a public outcry and the formation of a commission under former CPR President N.R. Crump to look into the affairs of the town and its only industry.

"The implications of this decision (to close the Number 5 mine) were widespread," said the commission's final report. "What had started as a 100-per cent underground mining operation was being turned into an operation likely to produce only one-third of its coal from underground operations. It meant a greater emphasis on the less labor intensive stripping operations . . . a less stable work force in terms of permanent residence in the community."

In April, 1973, according to the report, the company cancelled its original 15-year contract for a two-year contract, introducing new uncertainties and causing questions about the long-term viability of the community.

The town's population declined to about 2,500 by summer, 1973, said the report, and per-capita servicing costs for the lower population "can only be characterized as excessive."

A 1973 study commissioned by the town's research committee and endorsed by the Chamber of Commerce said McIntyre Mines did not spare its financial resources in an attempt to create a "model community." But, added the report, "social amenities and economic benefits may be irrelevant to human problems."

For one thing, said the study, people had little input into their own destinies. "They live in pre-planned houses, in a pre-planned community, with a choice of one economic base . . . and, ultimately, with built-in indebtedness dictating a high mill rate."

For another, "many ethnic groups were thrown into a social situation with which they were unfamiliar . . . the melting pot did not work. Instead, the lines of ethnic antagonism were consolidated." Antagonism also developed between Canadian miners and their British supervisors, said the study, and "tensions and conflicts developed into general unrest."

Back in Fort McMurray, Syncrude announced that it would leave its newly-placed foundations right where they were and pack up unless it got $1 billion in commitments from the various governments to ensure that extraction and marketing of the synthetic crude was economically viable. (Eventually Alberta, Ontario and the federal government provided the financial assurances.)

In Fort McMurray itself, between 30 and 50 per cent of the population lived in mobile homes. A half-dozen families refused to move from their homes so a new sewage treatment facility could be built there. Natives, mostly Cree and Metis, complained that they were being forced from their homes and land to accommodate the influx of newcomers. By 1976, housing prices had reached $70,000 for 'a modest home' and upwards of $90,000 for larger models in the new subdivisions.

The RCMP had no choice but to drive drunks home instead of locking them up. The town's facilities for two or three men were accommodating nearly 20. As if that wasn't enough, the townspeople spent most of April, 1977, wading through icy water flowing from the nearby Athabasca River. Damage was assessed at nearly $4 million.

More was yet to come. In an April, 1977 interview that appeared in the *Calgary Herald*, RCMP Inspector James Quinn labelled the oil boom town "a hide-out for criminals" who like the relative security of northern isolation and the big paycheques of workers.

"I heard of a man walking away with $50,000 from one (poker) game," said Quinn, adding that the big games attracted many construction workers during idle weekends.

According to Statistics Canada, offences under the Criminal Code of Canada doubled to 2,568 during the period 1972-1976. Drug offenses had jumped 38 per cent to 12 in one year.

With the population now boosted to 18,000, "our job can only become harder," commented Quinn. "We have our fair share of serious assaults, stabbings, woundings, shootings and that sort of thing now."

Meanwhile, McIntyre's more recently-negotiated Japanese coal contract was due

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*Fort McMurray townsite with new bridge, 1966.*24

*A new housing area in Fort McMurray.*25

*A new apartment complex to house Syncrude employees towers above a dilapidated shack.*26

*Grande Cache, 1972.*27

*Older trailer court, Fort McMurray.*28

to expire at the end of March, 1978, and the company's officials warned that one-third of the 750 workers could be without jobs. An 11th hour contract renewal averted any large-scale layoffs, but the contract was to be up again at the end of March, 1979.

The town of 4,300 couldn't support a dress shop, a sporting goods store, a machine shop or a television repair shop. Even as far back as 1973, the town's spokesmen were asking government to consider developing tourism in the Willmore Wilderness Park as a supplement to the erratic coal industry.

The Crump report said only two industries besides coal mining appeared to have "any prospect of significant success: tourism and forestry." It recommended that the province "undertake the promotion of the area for tourists and the development of facilities amenable to the development of wilderness areas."

LAURENDALE

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In 1978 the provincial department of business development and tourism announced that a consultants' report had been commissioned to look at possibilities for improving Grande Cache's economy by developments such as roads, ski resorts and alpine villages.

"Japan is going through its own recession," Derek Dukart, Grande Cache's town administrator, explains when asked about the ups and downs of the coal market.

He said in an interview that the town's last census, taken about 18 months ago, showed its population at 4,423. "It has dropped in the last year and a half; some people have left and we have a few houses sitting empty."

But the 66 men laid off by the mine in October have been hired back, he added.

Dukart is optimistic about the town and its future. "It was the early days when there were single men around here that we had the problems," he said. "Now, everybody is family oriented."

The town's $1.75-million budget is being balanced as stipulated under the new towns act. New economic life could be breathed into the town as a result of tourism or of logging, which is now being opened up east of Willmore Wilderness.

Vic Henning, commissioner of northeastern Alberta, is equally optimistic. He co-ordinates economic development in the area and is eager to talk about the proposed Alsands Project Group development in the oil sands, led by Shell Resources Canada Ltd., as well as Esso Resources Ltd.'s Cold Lake heavy oil project.

Henning acknowledges problems with balancing the budget in Fort McMurray; the town ran up a debt of nearly $20 million, of which $12 million will be wiped out by a provincial municipal debt reduction program.

"But the problems were more with financial planning which should be reduced by a cost impact model, on computer.

"It's amazing how the community has stabilized," continued Henning in an interview. "The wild tales of three or four years ago really annoy the local people. Fort McMurray is a good community. The cement that binds the thing are the people who work on the boards and committees. It's a very cosmopolitan place. It's young and vigorous."

The National Energy Board figures that, to reduce Canada's dependency on foreign oil supplies to almost nothing by the year 2,000, at least 15 oil sands plants would have to be built in northeastern Alberta. But the implications of 15, one to be built every 18 months, are almost staggering even when only considering the construction crews.

In any case, there's no doubt Fort McMurray will continue to be a boom town for years to come, although, according to a government report, there are still unmet social needs.

According to a 1978 report by the provincial health and social services department, "it seems to be taken for granted that resource towns have to exist in a crisis situation for years, then, given time, will eventually balance out on their own."

That statement goes beyond the context of health and social services for towns like Fort McMurray and Grande Cache, the latter of which is still in a state of limbo as it awaits new development schemes.

But the people of Grande Cache like to think they are keeping their options open. In their minds, they have accepted the fact that their town may have gotten off to a rough start, but they believe its future will be brighter and more resolute.

It is fortunate that if Fort McMurray had to be a one-resource town, it was based on oil. With declining conventional reserves and the instability of foreign suppliers, the oil near Fort McMurray will only get more and more attractive.

The hard times are over for Fort McMurray--at least for now--and the general consensus is that the town has handled them. It survived the break-neck speed at which the town grew, it survived the Saturday night brawls and the Sunday morning clean-ups.

Above all, it handled the label of being a 'frontier town' or a 'boom town.'

"Trapping isn't as big a thing as it used to be here," said Henning, "but if you go out by the airport, you can see the traplines running alongside of the runway."

Oil or no oil, some things never change.

Peter Morton is a journalist in Calgary

Syncrude Canada Ltd.

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Environment Protection at the Syncrude Site

Balancing birds and bitumen

The Syncrude Project at Mildred Lake, some 40 kilometres north of Fort McMurray, is well known to Albertans.

The project occupies 75 square kilometres, and involves recovery of oil from shallow oil sand deposits. This process requires three steps not found in conventional crude production. The oil sands must be **mined** and brought to a processing plant, where the oil (termed bitumen at this early stage of the recovery process) is **extracted** from the sand. After mining and extraction the bitumen must be **upgraded** until it resembles crude oil. This end product is called 'synthetic crude'. The three steps in the process each cause a different set of environmental problems.

Syncrude views resource extraction as only a temporary use of the land. Once the oil has been removed, Syncrude plans to return the land to its previous forest-related uses which include recreation and wildlife habitat.

This job can be made easier by careful advance planning, and by minimizing environmental damage during the operating phase of the project. Where possible, Syncrude is containing environmental damage within the boundaries of its lease, and is reclaiming the damaged areas as quickly as possible. Where the environment outside the lease boundaries could be affected, for example by the release of sulphur dioxide to the atmosphere, the company develops mathematical models to predict in advance what the concentrations will be. Once the plant is emitting pollutants, monitoring systems provide information on the actual concentrations while biological surveys record their effects.

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Within the lease, several steps are being taken to minimize environmental damage. To safeguard water quality, Syncrude keeps its process water separate from the lakes and creeks on the lease; the company has rerouted all of the creeks that once crossed the development area. This was done by digging the west interceptor ditch (see map)

*Oil sand being transferred from excavator to conveyor belt.*30

*Fluid cokers at Syncrude.*31

*Syncrude site showing extraction and power plant.*32

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and by building the Beaver Creek dam and Poplar Creek spillway.

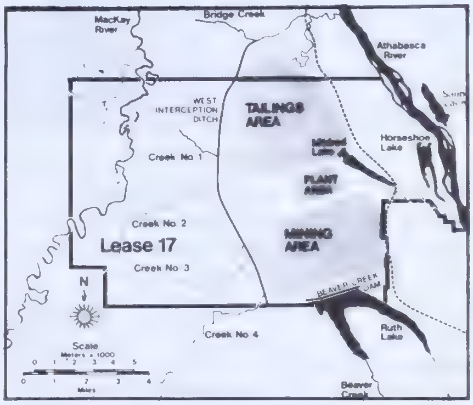
Monitoring stations on these creeks and on the Athabasca River provide a regular check on the effects of the project. Every one of the water bodies created by the diversion system is stabilizing and is biologically productive. In fact, the fish habitat of Poplar Creek has been improved by the addition of oxygen-rich water flowing in from the Beaver Creek diversion system.

Regarding mining and reclamation, in the years between 1978 and 2003, Syncrude's mining operations will create a hole 50 metres deep within a rectangle 4,300 metres by 7,600 metres. The middle portions of the rectangle will be back-filled even while mining is occurring on the ends.

Syncrude will begin to revegetate the middle parts of the mine pit long before the end of the project. The plan is to leave the area compatible with its undisturbed surroundings. Native shrub and tree seedlings, grown right at the Mildred Lake site, will be part of a mixture of plants that will be grown on the sand.

Tailings sand, left over from the mining process, by itself makes a very poor soil. Syncrude will contour the tailings sand into a gently rolling landscape, and then mix clay and peat (drained muskeg) into the top 30 centimetres of the sand to create an artificial soil. By short-cutting the natural processes of forest development, the company can establish a habitat fit for wildlife in a few years. Syncrude's objective is to create plant communities that need no fertilizer or irrigation once the vegetation becomes established.

About 180,000 cubic metres of water are used every day in the extraction process, which 'floats' bitumen away from the sand. Used water from the process is held on the lease in a tailings pond, which will eventually cover 28 square kilometres and reach an average depth of 40 metres. The pond is an environmental protection device. It not only holds waste water from the plant, but also enables the fine clay particles released from the tar sand in the extraction process to settle out. Once the clay has settled, the waste water can be re-used in the plant. About 50 per cent of Syncrude's water needs can be met by recycling and even more water could be re-used if a practical method could be found to make the clay particles settle faster.

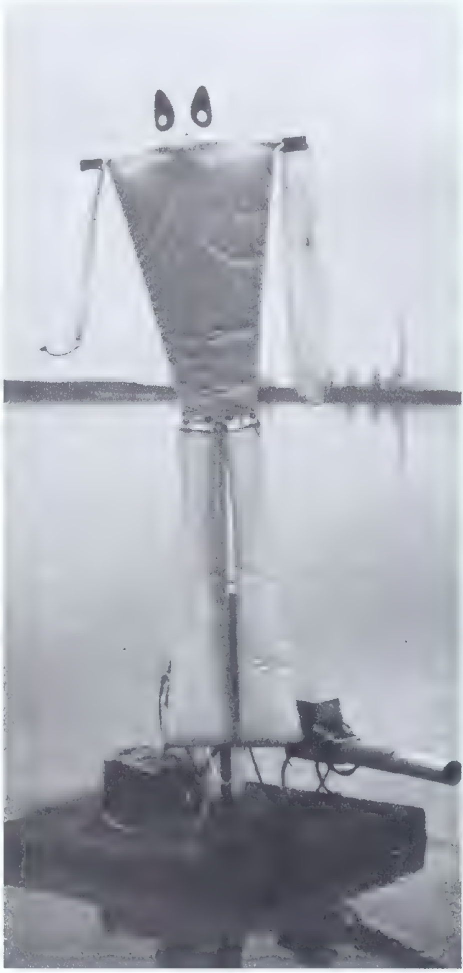


Ironically the tailings pond, which helps to solve the problems of surface water pollution and fresh water supply, poses its own problem: it may be a threat to waterbirds because it contains unrecovered bitumen from the plant. Because of the large size of the pond, migrating birds might find it attractive and wish to land on it to rest. If a waterbird should come into contact with bitumen on the pond, the bird's chances of survival would be low.

Syncrude is reducing the threat posed by the tailings pond with a three-way program. First, the pond is made relatively unappealing to birds. No vegetation will be allowed to grow on its edges, and any floating mats of vegetation will be cleared away. (Meanwhile the water bodies created by the Beaver Creek diversion are attractive to waterfowl and may serve to draw birds away from the tailings pond.)

*'Scarecrow' used to keep birds from tailings pond.*33

*Close-up of lichen, which acts as an early biological warning system.*34



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The second part of the approach is to keep the pond as free of bitumen as possible. Syncrude is actively seeking the best ways to reduce the amount of bitumen that enters the pond, and to confine the oil to a small area.

Thirdly, birds will be kept away from the oily parts of the pond. Syncrude has built several dozen mechanical scarecrows, each of which performs a reasonable imitation of a hunter. Each device consists of a two-metre-tall figure and a propane noisemaker mounted on a raft. The figure is balanced to move erratically with the slightest breeze, while the noisemaker produces a sound like a shotgun blast every few minutes.

The devices cause birds to be uncertain about approaching the tailings pond, and during field testing in the fall of 1978, migrating waterbirds overwhelmingly avoided the pond.

In the future Syncrude will keep working on innovative ways to solve the tailings pond problem.

In the upgrading plant the thick, heavy bitumen is transformed into synthetic crude oil capable of being transported long distances by pipeline.

Part of the process involves removing sulphur from the bitumen. Since bitumen is about five per cent sulphur by weight, Syncrude has to contend with about 1,350 tonnes of sulphur every day. Of this tonnage, just over 89 per cent (1,207 tonnes) is removed during the upgrading process and stored on the lease, while the remainder, 143 tonnes, is discharged to the air from a 183-metre stack, in the form of SO_2 (sulphur dioxide).

In Alberta, emission rates and stack design are established before a company is granted a permit to construct. As part of the planning process, the company predicts ground level concentrations, using information about the stack design, emission rates and local atmospheric conditions. The concentrations must remain within limits specified by Alberta Environment.

There are three independent air quality monitoring systems around the Syncrude plant. The most sophisticated is a network of five stations which measure SO_2, H_2S (hydrogen sulphide), temperature and wind data on a minute-by-minute basis, and report to a central station at the plant.

In addition, pairs of static 'candles' at 40 locations around the site measure total sulphur exposure on a monthly basis.

The above two systems are required by Alberta Environment for Syncrude's licence to operate under Alberta's Clean Air Act.

For Syncrude's own information, the company has established 56 plots, in a radial pattern extending up to 35 kilometres from the plant, where lichens are monitored as a biological early warning system. Lichens are more sensitive than most higher plant forms to small changes in air quality. The lichens are to be checked with annual surveys for the first few years of operations and at longer intervals subsequently.

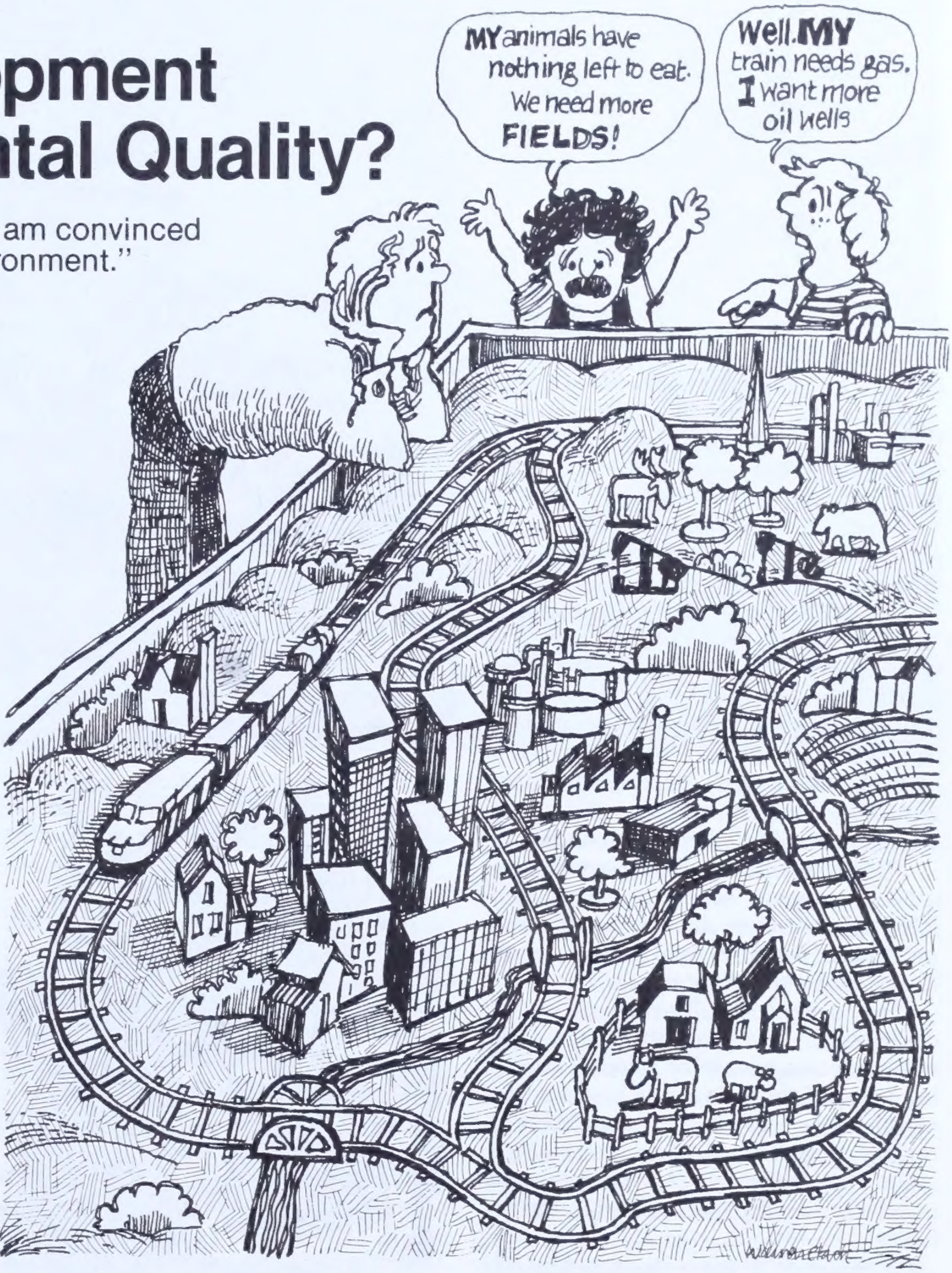
In summary, sound design principles and regular monitoring of air and water quality are fundamental to the achievement of Syncrude's goal of returning the land to its previous uses. Over its 25-year operating life Syncrude will prove that large resource projects can be operated within today's high standards of environmental quality.

Stuart Elliot, Environmental Co-ordinator, Syncrude Canada Ltd.

Carl Primus

Energy Development or Environmental Quality?

"If we take the longer-term view, I am convinced that we can have energy *and* environment."


MY animals have nothing left to eat. We need more FIELDS!
Well. MY train needs gas. I want more oil wells

"*We have reached the point where we must knowingly and rationally determine the (environmental) tradeoffs which must be made when resource utilization occurs.*"

This comment was made by Carl Primus, director of the planning division of Alberta Environment, in a presentation delivered to the 1978 Canadian Resources Association convention and reprinted in the *In-Site* magazine last October.

"What is the nature of these tradeoffs which must be determined?" asked Primus.

"The controversy which usually surrounds any large-scale energy development nowadays highlights one or more of the concerns that individuals or groups may have. The Alberta Oil Sands Environmental Research Program . . . has identified four environmental systems: air, water, land and human, and these four systems can be used to categorize the major concerns or potential tradeoffs associated with energy developments.

"Dealing first with *the air system* . . . the production of energy may result in air pollution. What are the tradeoffs involved? The basic tradeoff is between the cost of emission control equipment and the risks incurred by exposure to pollutants. The risks include reduced soil productivity and, in extreme cases, soil sterilization; direct and indirect damage to vegetation and wildlife, and health hazards to people.

"The cost of increasing emission control recovery, measurable for capital equipment and for annual operating expenses, can be passed directly to the users of the energy produced. The benefits of reducing emissions are less rapidly recovered and are probably impossible to measure with any degree of accuracy. Society, then, through its regulatory agencies, must make the judgment as to what is the acceptable balance between cost of production and risk-taking.

"*The land system*, which is concerned with physical, chemical and biological changes to the baseline states of terrestrial ecosystems resulting from energy developments, is more complex and accordingly has a greater potential for impact.

"In energy development, the activity of greatest concern is the modification of a specific land area, such as flooding by a reservoir or excavation by a strip mine. The results of modification to land surfaces include loss of soil productivity or production; disruption of transportation routes, including bird and animal migration, and fish movements for spawning, as well as roads and railroads; effects on the water system such as increased sedimentation and disruption of surface and groundwater flow; and possible effects on the air system (such as) increased dust from exposed land surfaces or changes in the micro-climate of an area.

"With regard to *the water system*, the effects of energy development range from reservoir construction with the attendant potential for loss of habitats, blockage of movement and modification of flow regime, to water use for thermal power generation with the attendant potential for withdrawal of water and the addition of pollutants in the form of increased total dissolved solids and increased water temperatures.

"The tradeoffs may be relatively straightforward (energy production versus agricultural production) or more complex (single purpose use which maximizes energy production versus multiple-purpose use which

*Sign on an Edson area oil and gas plant.*36
*Edmonton's blazing skyline.*37

LAUREN DALE
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usually results in sub-optimum use of each component such as power production, flow regulation, flood control and recreation).

"The tradeoffs become particularly difficult when dealing with quantifiable benefits--megawatts of power--versus unquantifiable costs such as loss of sport fishing. . . .

"Lastly, *the human system* is concerned with demographic patterns and social conditions, and the changes which may occur in these as a result of energy development. Activities range from temporary community disruption during the construction phase of a large project, to the long-term modification of lifestyles, either by reducing or eliminating the resource base on which a particular lifestyle is dependent--fishing and trapping in northern communities, arable land in rural farming communities. . . .

"The tradeoffs are usually between increased economic activity (such as) new jobs, higher incomes, income security, and provision of higher levels of services, versus loss of property or lifestyle.

"As to the (overall) effects of energy development, one could think of a scale measuring magnitude of impact. At the lower end of the scale would be extraction of natural gas and oil, and subsurface coal mining. Impacts tend to be site specific--roads, well sites, pipelines--with little or no direct water use and minimal surface disturbance.

"Mid-range in the scale would be enhanced oil field recovery, heavy oil recovery (and) in-situ oil sands development, which require process water and which may have byproducts that present disposal problems. These processes are themselves energy consumptive, particularly those requiring steam.

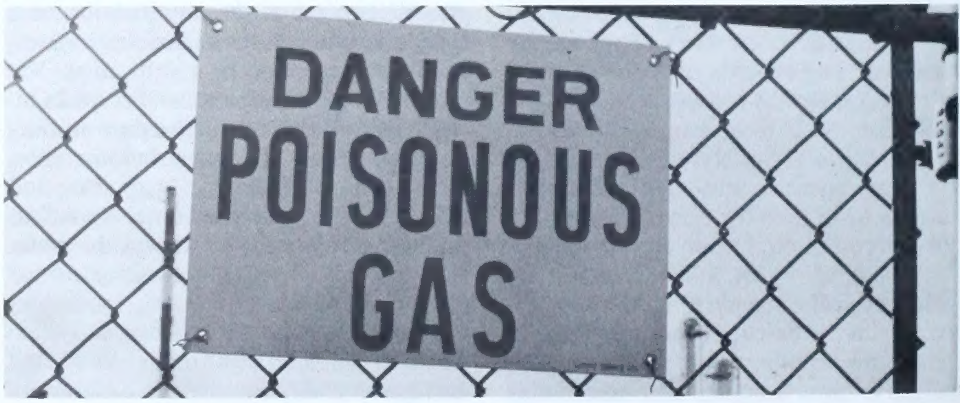
"One obvious tradeoff in such a process is to ensure that there is a net gain in energy production. One assumes that economics would dictate this; however, if a low-value energy source (coal) is substituted for a high-value energy source (synthetic oil) the net BTU gain may still be small.

"At the high end of the impact scale are the surface coal mining operations and the surface oil sands recovery operations. These, of course, result in major surface disturbance, alteration of surface and groundwater flows, loss of agricultural production and, in settled areas, disruption of community.

There. That should take care of all my energy needs

"A major potential energy source in Alberta are the oil sands deposits . . . the types of tradeoffs involved include potential impacts on the air system because raw sulphur is a byproduct of the recovery and refining process, and potential impacts on the land system. The major concern is the handling of the waste material and the restoration of the mined area.

"The strip mining process results in overburden material which must be replaced, and the refining process results in tailings which must be disposed of. The tailings present the greatest challenge, since the



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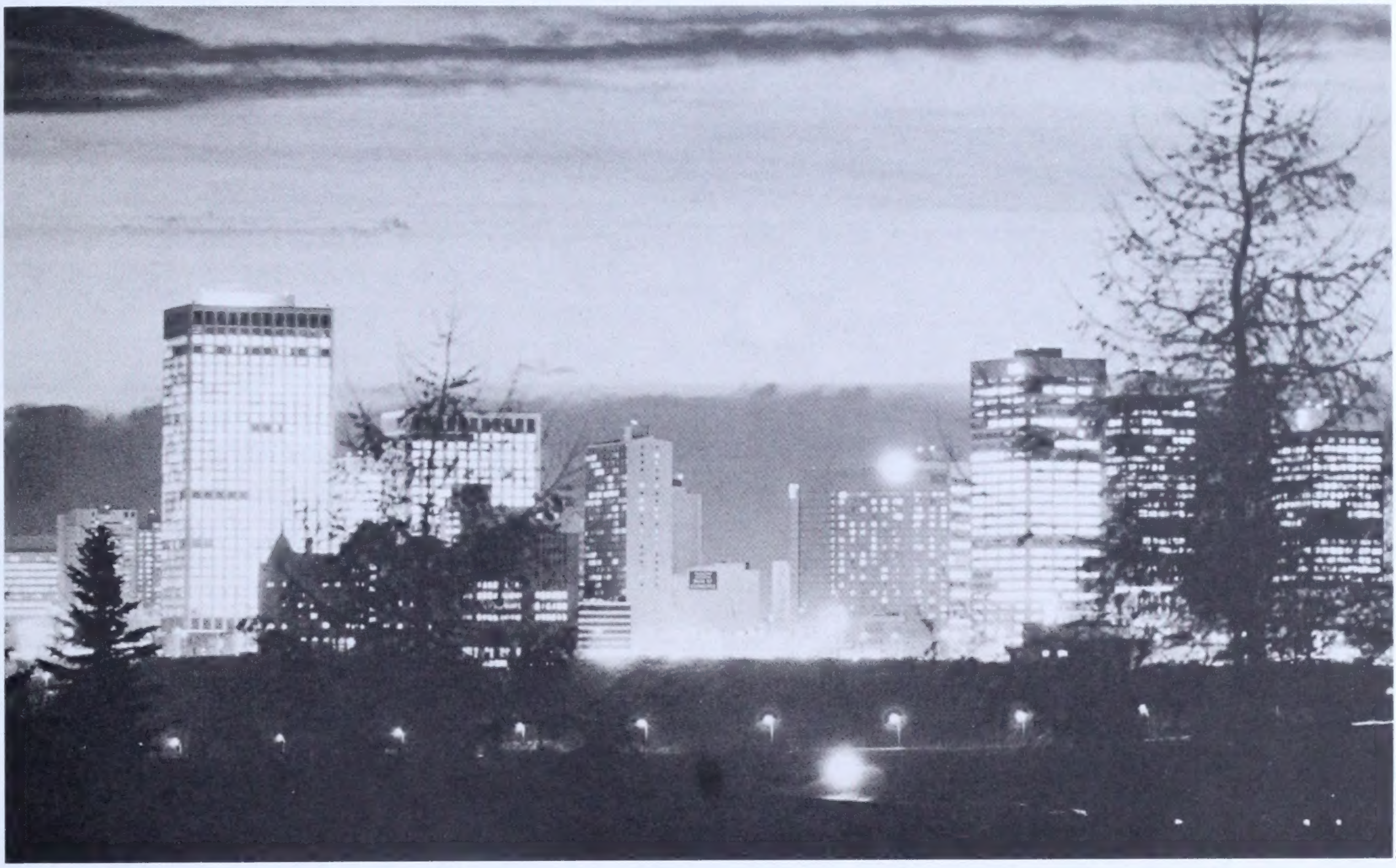

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residual solids and associated water will occupy a volume of up to 30 per cent greater than the void space of the original material. Thus the reclaimed mine area could be up to 100 feet (30 metres) higher than the surrounding terrain. Research and field investigation techniques are available to restore the mined area.

"Utilization of Alberta's coal resources has an even greater potential for environmental impact. For example, coal-bearing formations underlie 117,000 square miles (304,000 square kilometres) or 46 per cent of the province. Of course, not all of these formations contain economically recoverable coal. Ultimate remaining in-place reserves are broadly estimated to total 140 billion tons (126 billion tonnes), of which 45 per cent is expected to be recoverable eventually. Proven recoverable reserves near the surface total some 7.5 billion tons (6.8 billion tonnes).

"The largest users of Alberta coal are coal-fired thermal electric power generating stations. A new proposed plant, which is currently before the Energy Resources Conservation Board, would be located on a coalfield with an estimated recoverable reserve of approximately 150 million tons (135 million tonnes). Assuming a 30-year lifetime for the plant, some 55 million tons (50 million tonnes), or 37 per cent of the reserves, would be used. Thickness of the overburden varies from 15 to 40 feet (4.5 to 12 metres). On an average, 160 acres per year will be mined for a total of 7.5 square miles of land (19.5 square kilometres) being strip-mined.

"The tradeoffs involved in this proposal include loss of agricultural land, presumably on a temporary basis if reclamation standards are met; disruption of community, both by introducing a new and relatively large workforce into the area, and by reducing the agricultural viability of the area; and potential water-use conflicts in a region with a limited water supply.

"These figures illustrate the magnitude of potential impacts associated with energy developments. We are all familiar with the types of impacts involved. So what are the tradeoffs which must be made to gain energy production?

"If we take short-term economic gain as the primary criterion, then we have energy or environment. Energy production will be gained at the expense of other resources, agricultural production, fish and wildlife, recreation, and that ill-defined resource called quality of life.

"However, if we take a longer-term view, then I am convinced that we can have energy and environment. The net result of this approach is, of course, higher priced energy to the consumer, since the least-cost energy source may not be the acceptable one. This can be illustrated by the current policy on coal development. The greatest percentage of coal recoverable by strip mining is located in the plains region of the province, the same region which has the greatest agricultural capability. Before a strip-mine operation will be permitted on arable land, it must be shown that the land can be returned to agricultural production to at least the same level of productivity as before mining occurred. Where current technology cannot give such assurances, development will be delayed until such time as the means of reclaiming the land is assured. One major thermal generating plant application has already been rejected on these grounds.

"The same reasoning must be applied to other energy development. The most stringent regulation(s) required to ensure adequate environmental protection must be applied. Where current technology cannot secure such protection, alternate energy sources must be developed.

"This is not to suggest that our energy resources can be developed without associated costs. The responsible approach is to understand the consequences of each proposed energy development, to design means of mitigating undesirable effects and to include funds for the rehabilitation and restoration of affected areas in the cost of energy production from each development."

If undelivered, return to:

Environment Views
Alberta Environment
9820 - 106 Street
Edmonton, Alberta T5K 2J6

Environment Update

Cabinet Changes

Alberta Environment's new minister, announced in March following the Progressive Conservative Party's decisive election victory, is Jack Cookson, a 50-year-old farmer and teacher from Lacombe. He replaces Dave Russell of Calgary Elbow, who has become the minister of hospitals and medical care. Changes in cabinet portfolios included the removal of the wildlife branch from recreation, parks and wildlife, and the creation of a new public lands and wildlife department.

Classroom Projects Planned

Power for People is the name of the Edmonton Public School Board's new Grade 6 environmental education unit focusing on energy. Developed by classroom teachers themselves, it's the first of a number of curriculum projects aimed at helping teachers deal with energy issues like conservation.

Similarly, in Calgary seven teachers have produced *Energy Conservation: A Curriculum for Living,* two major curriculum packages. One for kindergarten to Grade 6 will soon go to printer and the second, for Grade 7 through 12, should be in the schools by September. For more information, write Energy Conservation Curriculum Project, Calgary Board of Education, 515 MacLeod Trail S.E., Calgary T2G 2L9.

The most ambitious undertaking of all, *S.E.E.D.S.* (Society, Environment and Energy Development Studies), is a grade-by-grade curriculum project now being tested, in draft form, in more than 130 classrooms throughout Alberta. The first final products of the non-profit industry-sponsored foundation are slated to come off the press in January, 1980. For more information write S.E.E.D.S., 406 - 10169 - 104 St., Edmonton.

Report Criticized

Ten of Alberta's major environmental groups have formed a united front to criticize proposed development at Lake Louise. The groups base their objections on the $350,000 Lake Louise interim development report prepared for Parks Canada. The development would involve upgrading facilities and providing accommodation for 1,600 visitors.

The groups have called for a long-term study of possible adverse effects on wildlife and a full-scale environmental assessment of the development plans. Public sessions to discuss the plans have been held in Edmonton, Red Deer, Banff and Calgary, as well as Lake Louise. A final decision is expected from Indian and Northern Affairs Minister Hugh Faulkner in June or July.

Nuclear Need Cited

Nuclear reactors may be needed to supplement oil and coal as Alberta's major sources of energy before the end of this century, according to two speakers at last month's meeting in Edmonton of the Industrial Developers' Association of Canada. Marshall M. Williams, president of Calgary Power Ltd., predicted that one or more nuclear stations could be needed for Alberta's power grid by the end of the 1990s. James Donnelly, president of Atomic Energy of Canada Ltd., said nuclear energy could play a role in extending Alberta's petroleum resources by providing the energy to unlock the fuel potential of heavy oils, tar sands and coal.

Hearings End

The Energy Resources Conservation Board has concluded its public hearings on a Calgary Power application to build two 500-kilovolt transmission lines from the company's proposed Keephills power station 60 kilometres east of Edmonton to that city. Board Chairman Vern Millard said a decision on the application will not be made for several months.

Pipeline Ruptures

About 20,000 people in the Edmonton subdivision of Mill Woods were evacuated from their homes overnight March 2, when a pipeline carrying liquid propane was found to be ruptured. A truck driving above an underground pipe sparked a massive explosion of the propane, which is believed to have vaporized in the warmer weather. The gas then backed into sewer lines, posing an extra hazard to residents. The Energy Resources Conservation Board will hold an inquiry into the cause of the line rupture in April.

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Solar Test Funded

The University of Alberta has been awarded a $250,000 grant to finance a three-year project on solar energy studies. The project will involve construction of six test houses. Initially, research will focus on 'super-insulation' techniques and passive solar heating. Funds from the project come from the $96 million Canada/Alberta Energy Resources Research Fund.

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.